UNIVERSITY OF Southampton

University of Southampton Research Repository

Copyright © and Moral Rights for this thesis and, where applicable, any accompanying data are retained by the author and/or other copyright owners. A copy can be downloaded for personal non-commercial research or study, without prior permission or charge. This thesis and the accompanying data cannot be reproduced or quoted extensively from without first obtaining permission in writing from the copyright holder/s. The content of the thesis and accompanying research data (where applicable) must not be changed in any way or sold commercially in any format or medium without the formal permission of the copyright holder/s.

When referring to this thesis and any accompanying data, full bibliographic details must be given, e.g.

Thesis: Author (Year of Submission) "Full thesis title", University of Southampton, name of the University Faculty or School or Department, PhD Thesis, pagination.

Data: Author (Year) Title. URI [dataset]

UNIVERSITY OF SOUTHAMPTON

Faculty of Engineering and Physical Sciences
School of Electronics and Computer Science

Bridging Contexts in Video-Based Virtual Dyadic Communication: From Asynchronous Non-Familiar Contexts Using Pre-Recorded Introductions to Synchronous Familiar Contexts Operationalising Engagement Metrics

DOI: 10.5258/SOTON/PG/T257

by

George-Catalin Muresan
BSc (Hons),MSc
ORCiD: 0009-0004-8157-3616

A thesis for the degree of
Doctor of Philosophy

May 2026

University of Southampton

Abstract

Faculty of Engineering and Physical Sciences
School of Electronics and Computer Science

Doctor of Philosophy

Bridging Contexts in Video-Based Virtual Dyadic Communication: From Asynchronous Non-Familiar Contexts Using Pre-Recorded Introductions to Synchronous Familiar Contexts Operationalising Engagement Metrics

by George-Catalin Muresan

Video-based dyadic communication is central to remote collaboration but often suffers from conversational imbalance, reduced trust, and disengagement due to the absence of in-person cues. These challenges vary with participant familiarity: unfamiliar dyads may face initial awkwardness and low trust, while familiar ones often experience unbalanced dynamics and limited turn-taking awareness. Despite the prevalence of virtual one-on-one meetings, structured interventions to support engagement across both contexts remain rare. This thesis addresses that gap through the design and evaluation of two solutions targeting asynchronous and synchronous interaction phases.

The first introduces Asynchronous Self-Guided Professional Introductions (ASGPIs) - structured pre-meeting video recordings that reduce awkwardness and foster trust. A controlled study showed that video-based ASGPIs significantly improved perceived team effectiveness and trust over text-based or no-introduction conditions. The second, focused on familiar dyads, presents a synchronous real-time feedback system visualising speaking balance, interruptions, and pauses through a subtle, user-informed dashboard. In a second study with returning participants, the system improved conversational equity, satisfaction, and behavioural self-awareness while reducing stress.

Together, these interventions form a novel framework for enhancing engagement across unfamiliar and familiar video-based dyads. The research demonstrates how asynchrony and synchrony can be applied as design strategies: asynchronous introductions to build trust, and perceived effectiveness, and synchronous feedback to support conversational awareness and balance. Contributions include the ASGPI framework, a professional familiarity questionnaire, formalised engagement metrics, and design principles for lightweight, adaptive, user-informed tools in professional, educational, and social settings.

Contents

List of Figures **ix**

List of Tables **xi**

Declaration of Authorship **xiii**

Acknowledgements **xv**

Abbreviatons **xix**

1 Introduction **1**
1.1 Context & Motivation 1
1.2 Why Does this Transition into the Virtual Matter? 3
1.3 Governing Stance: Designing for the Triangular State of Team Dynamics 4
1.3.1 Foreground and Background Theories 6
1.4 Proposed Solutions 7
1.5 Design Scope, Baselines, and Feasibility Framing 9
1.5.1 Methodological Concepts Used in the Evaluation Design 10
1.5.2 Rationale for Dyads, Measurement Suitability, and Scalability Limits 10
1.5.3 Measurement Reliability and Justification of Instrument Choices 11
1.5.4 Feasibility Positioning and Implications for Inference 12
1.6 Research Contribution 12
1.7 Thesis Structure 15
1.8 Summary 16

2 Related Work **19**
2.1 Introduction 19
2.1.1 Review Approach, Scope, and Selection Logic 20
2.2 The Role of Engagement in Video-Based Dyadic Meetings 24
2.2.1 Why Focus on Dyads? 24
2.2.2 Engagement Challenges in Virtual Communication 25
2.2.3 Elements of Engagement: Discrepancies Between Virtual and In-Person Interaction 31
2.3 Governing Lens: The Triangular State of Team Dynamics in Virtual Dyadic Communication 34
2.4 Foregrounded Psychological Theories Supporting Intervention Design . 36

2.5 Asynchronous Contexts: Out-of-Meeting Communication and Delayed Interaction . . . 38
2.5.1 The Role of Asynchronous Communication in Virtual Collaboration 38
2.5.2 Theoretical Perspectives on Delayed Interaction and Engagement 41
2.5.3 Mapping ASGPIs . . . 42
2.6 Synchronous Contexts: In-Meeting Conversational Dynamics . . . 43
2.6.1 The Role of Real-Time Communication in Virtual Collaborations 43
2.6.2 Theoretical Perspectives on Real-Time Interaction and Cue Adaptation . . . 45
2.6.3 Mapping Feedback on Engagement Metrics . . . 48

3 Asynchronous, Unfamiliar Contexts 51
3.1 Introduction . . . 51
3.1.1 Research Questions . . . 52
3.2 Related Work . . . 53
3.2.1 Impact of the COVID-19 Pandemic on Remote Work . . . 53
3.2.2 Interaction Challenges in Remote Work . . . 54
3.2.3 The Role of Dyadic Structures in This Research . . . 55
3.2.4 Trust and Perceived Team Effectiveness . . . 57
3.2.5 Introductions . . . 58
3.3 Apparatus: ASGPI and the Professional Familiarity Questionnaire . . . 61
3.3.1 Deconstruction in HCI as a Design Technique . . . 61
3.3.2 ASGPI . . . 61
3.3.3 Professional Familiarity Questionnaire . . . 62
3.4 Implementation of the ASGPI System . . . 64
3.4.1 High-Level Architecture . . . 65
3.4.2 Deployment Setup and Development Environment . . . 66
3.4.3 Back-End Implementation Details . . . 66
3.4.4 Front-End Implementation Details . . . 67
3.4.5 Data Analysis & TDS Scripts . . . 69
3.4.6 Design Rationale & Benefits . . . 69
3.4.7 Summary of Implementation . . . 70
3.5 Study Design and Methodology . . . 70
3.5.1 Recruitment and participants . . . 71
3.5.2 Study Set-up and Participant Pairing . . . 71
3.5.3 Creating the ASGPI . . . 72
3.5.4 Virtual Video Meeting . . . 73
3.5.5 Post-study survey: Assessment Instrument for Perceived Team Effectiveness . . . 75
3.6 Results . . . 76
3.6.1 Experimental Procedure . . . 77
3.6.2 Perceived Team Effectiveness: TDS Results . . . 79
3.6.3 Analysis of Dyadic Interactions Across Experimental Conditions 81
3.6.4 Themes: Analysis of Participant Feedback and Insights on Collaboration . . . 83
3.7 Discussion . . . 86
3.7.1 Impact of Asynchronous, Semi-Guided, Professional Introductions 86

3.7.2 Limitations . . . 91
3.7.3 Future Work Considerations . . . 93
3.8 Conclusion . . . 93

4 Synchronous, Familiar Contexts **97**
4.1 Introduction . . . 97
4.1.1 Research Question . . . 99
4.2 Related Work . . . 100
4.2.1 Social Engagement in Video-Based CMC . . . 100
4.2.2 The Role of Dyadic Structures in This Research . . . 101
4.2.3 Operationalising Conversational Cues as Engagement Metrics . . . 102
4.2.4 Feedback Mechanisms in CMC and HCI . . . 105
4.2.5 Tools to Support Digital Communication . . . 107
4.3 Apparatus: Engagement Metrics - Definitions and Real-Time Computation 109
4.4 Study 1: Exploring Awareness of Engagement Metrics . . . 110
4.4.1 Research Questions . . . 111
4.4.2 Study Design and Methodology . . . 112
4.4.3 Results . . . 118
4.4.4 Discussion . . . 122
4.5 Study 2: Refining Real-Time Feedback Mechanisms . . . 127
4.5.1 Research Questions . . . 127
4.5.2 Study Design and Methodology . . . 128
4.5.3 Results . . . 137
4.5.4 Discussion . . . 143
4.6 General Discussion . . . 148
4.6.1 Synthesis of Findings . . . 148
4.6.2 Implications for the Design of Automated Engagement Feedback Mechanisms . . . 149
4.6.3 Empirical and Methodological Contributions . . . 150
4.6.4 Future Research Directions . . . 151
4.7 Conclusion . . . 154

5 Conclusions **157**
5.1 Overarching Focus and Research Questions . . . 157
5.2 Answer to the Overarching Design Question . . . 158
5.3 Synthesis: Implications for the Governing Triangular State of Team Dynamics . . . 160
5.3.1 How the Findings Advance the Governing Stance . . . 160
5.3.2 How the Findings Nuance the Governing Stance . . . 161
5.3.3 Governing Stance: Nodes and Edges . . . 161
5.3.4 Interpretive Scope of the Qualitative Findings . . . 162
5.3.5 What the Findings Do Not Establish . . . 163
5.4 Positioning the Theoretical Accounts Used in This Thesis . . . 164
5.5 Summary of Contributions . . . 165
5.6 Applied and Ethical Implications for Real-World Deployment . . . 167
5.6.1 Reusability Trade-offs Across Meeting Phases: Authenticity, Staleness, and Scale . . . 167

5.6.2 Privacy, Surveillance, and Power Asymmetries Across Interventions . . . 168
5.6.3 Priming, Demand Characteristics, and Behavioural Shaping . . . 169
5.6.4 Feasibility Framing and Organisational Adaptation . . . 169
5.7 Limitations . . . 170
5.7.1 Ecological Validity, Task Structure, and Observation Effects . . . 171
5.7.2 Limitations of the ASGPI Evidence Base . . . 173
5.7.3 Limitations of the Engagement Feedback Evidence Base . . . 174
5.8 Future Research Directions . . . 175
5.9 Closing the Loop . . . 177
5.10 Final Remarks . . . 178

Data Availability **181**

Appendix A Supporting Materials (Chapter 3) **183**
Appendix A.1 Participant Information Sheet . . . 183
Appendix A.2 Appendix: Problem Solving Tasks . . . 185
Appendix A.2.1 Insight problems . . . 185
Appendix A.2.2 Incremental problems . . . 186
Appendix A.3 TDS: Team Effectiveness Process Criteria . . . 186
Appendix A.3.1 Effort-Related Process . . . 187
Appendix A.3.2 Strategy-Related Process . . . 187
Appendix A.3.3 Knowledge and Skill-Related Process . . . 187

Appendix B Supporting Materials (Chapter 4) **189**
Appendix B.1 Participant Information Sheet . . . 190
Appendix B.2 Study 1 . . . 192
Appendix B.2.1 Sign-Up Questionnaire . . . 192
Appendix B.2.2 C1 Post-Experiment Questionnaire . . . 195
Appendix B.2.3 C2 Post-Experiment Questionnaire . . . 197
Appendix B.2.4 List: Topics of Discussion . . . 199
Appendix B.3 Study 2 . . . 204
Appendix B.3.1 Sign-Up Questionnaire . . . 204
Appendix B.3.2 Mid-Experiment Questionnaire . . . 207
Appendix B.3.3 Returning Participants: Post-Experiment Questionnaire 208
Appendix B.3.4 New Participants: Post-Experiment Questionnaire . . . 211
Appendix B.3.5 Collaborative Role-Play Games . . . 214

References **217**

List of Figures

1.1 Increase in remote working among UK employees from 2019 to 2024, based on ONS data. The COVID-19 pandemic prompted a sharp increase in remote work, which has since stabilised at a much higher level than before the pandemic. Globally, 91% of workers report a positive view of remote work, underscoring the enduring appeal and acceptance of flexible working arrangements (Hooson, 2025; Buffer, 2023). 2

3.1 Participant using our platform to record their video-based ASGPI. 73
3.2 Four stages of the experiment and outline of steps, 1. the process of onboarding; 2. pre-meeting preparation through scheduling and self-disclosure record; 3. zoom meeting; 4. post-experiment survey. 76
3.3 Distribution of study participants by (3A) Age; (3B) Gender; and (3C) Geographical region. 77
3.4 The total number of interactions (the summary of articulated suggestions and questions) across the dyads of each experiment condition: NC, TV, and VC. Illustrated by the yellow trendline is the average of the interactions in each condition. 82

4.1 Feedback sheet provided electronically to participants individually and privately during the 5-minute inter-session break. Participants were instructed to review the feedback independently, which highlighted their engagement metrics from the first session, before joining the second Zoom meeting. They were invited to return to the experiment once they confirmed they had read and understood the feedback. 115
4.2 Screenshot of the real-time feedback setting on the Miro platform. Participants were instructed to keep Miro open on half of their screen alongside the Zoom meeting, positioning their view to display only their assigned feedback box (indicated by their participant ID). Real-time notifications (right) would appear within this box when triggered by the experimenter, preventing participants from viewing each other's feedback and maintaining privacy of engagement cues. 115
4.3 Participant Login Interface – The initial dashboard screen where participants input their initials to access the feedback system. 132
4.4 Race-Track Visualisation Interface – The main feedback dashboard displaying the race-track visualisation, shown after the participant entered their assigned Participant ID to log in. This ID was used to match each participant with their pair and retrieve the appropriate session data from the database. 132

4.5 Blue Notification for Being Interrupted – A visualisation of the blue notification system, including a glowing light, an updated counter, and a sliding notification from the left-hand side, indicating the participant was interrupted. 132
4.6 Red Notification for Interrupting – A visualisation of the red notification system, including a glowing light, an updated counter, and a sliding notification from the right-hand side, indicating the participant interrupted their partner. 132
4.7 White Notification for Intra-Pauses – A visualisation of the intra-pause notification system, featuring a white-coloured counter and a sliding notification on the right-hand side of the screen. 133
4.8 Inter-Pause Counter – A visualisation of inter-pauses, represented solely by a counter displayed at the bottom of the screen to minimise distraction. 133
4.9 Race-Track Visualisation for Speaking Balance – A dynamic representation of speaking balance, showing user progress with a ball moving along a race-track based on speaking time. The track is capped at 10 minutes, with the ideal balance being achieved when both participants' balls are centred at the 5-minute mark. 133

List of Tables

3.1 The Professional Familiarity Questionnaire is based on the five key attributes of professional familiarity, comprising of a set of questions each: competencies, reputation/integrity, work performance, dependability, and attention to detail. These questions are adapted from various sources in the literature to comprehensively evaluate professional familiarity. . . 63
3.2 Descriptive Statistics for cognitive task completion time (in seconds) and accuracy, along with the Shapiro-Wilk statistical test of normality. 78
3.3 Independent samples t-test results for cognitive performance (Completion Time and Accuracy) with equal variances assumed (non-significant Levene's Test, $p > 0.05$) 79
3.4 TDS results: Descriptive statistics for perceived team effectiveness, along with the Shapiro–Wilk statistical test of normality. 79
3.5 TDS results: One-way ANOVA to compare effects interventions (VC, TC, and NC) on TDS' subdimension score - Teams' perceived effectiveness. 80
3.6 Tukey's HSD post-hoc multiple comparisons over conditions for perceived team effectiveness (TDS Subdimension score) *The mean difference is significant at the 0.05 level. 80

4.1 Descriptive Statistics for each Engagement Metric in each of the two conditions, along with the Shapiro-Wilk test of normality. 119
4.2 Comparison of Interruptions, Intra-Pauses, and Inter-Pauses Between First and Second Meetings for all participants. This table includes statistical test outcomes (T-Test or Wilcoxon Test), with corresponding test statistics and p-values. Speaking balance was excluded from this table as it was tested separately using a binomial test under Hypothesis H1.4, due to the binary nature of that outcome (i.e. whether the speaking balance changed or remained stable between meetings). Results in this table highlight significant behavioural changes across the two meetings, emphasising differences in participant interaction patterns. 119
4.3 Descriptive statistics and Shapiro-Wilk normality test results for awareness of engagement metrics in the first and second meetings, where Likert scale responses were transformed into scores ranging from 1 (Not at all aware) to 5 (Extremely aware). 121
4.4 Paired t-test results comparing awareness of engagement metrics between the first and second meetings. 121
4.5 Descriptive Statistics for each Engagement Metric, along with the Shapiro-Wilk test of normality. 138

4.6 Comparison of Interruptions, Intra-Pauses, and Inter-Pauses Between First and Second Meetings for all participants in C1. This table includes the statistical test outcomes (T-Test or Wilcoxon Test) including the test statistic values and p-values. Results highlight significant changes in interaction metrics, emphasising differences in participant behaviour across the two meetings. 138
4.7 Descriptive statistics and Shapiro-Wilk normality test results for awareness of engagement metrics in the first and second meetings, where Likert scale responses were transformed into scores ranging from 1 (Not at all aware) to 5 (Extremely aware). 139
4.8 Paired t-test results comparing awareness of engagement metrics between the first and second meetings: for new and returning participants. 140
4.9 Mann-Whitney U-test results comparing awareness of engagement metrics between the new participants and returning participants across the engagement metrics. 140
4.10 Descriptive statistics and Shapiro-Wilk normality test results for the ICSI standardised test conducted before and after participants received feedback. Responses were measured on a 7-point Likert scale, with scores ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). 142
4.11 Wilcoxon signed-rank test results for the ICSI standardised test. The table evaluates whether there were significant differences in participants' communication satisfaction levels, as measured on a 7-point Likert scale before and after feedback. 142

Declaration of Authorship

I declare that this thesis and the work presented in it is my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. Parts of this work have been published as: detailed in the Introduction chapter, which lists both published and submitted papers associated with this thesis.

Signed:..... Date: 13 May 2026

Acknowledgements

I would like to express my sincere gratitude to Professor Christopher Freeman, Dr. Indu Bodala, and Professor m.c. schraefel for their invaluable guidance, encouragement, and support throughout the course of this research. Their expertise, thoughtful feedback, and continuous belief in the work have been instrumental in shaping this thesis. I am also grateful to the examiners for their insightful and constructive feedback, which has helped improve this work.

My deepest thanks go to my loved ones, whose love, patience, and encouragement have supported me at every stage. Their belief in me made this journey possible.

To my friends - thank you for your kindness, humour, and support through the many ups and downs.

I gratefully acknowledge the Faculty of Engineering and Physical Sciences for their support throughout the PhD and for fostering an environment in which this research could thrive.

I also wish to thank all those I have collaborated with, been mentored by, and learned from during this time. Their input not only enriched this thesis but also helped bring parts of this work to publication. A special thanks goes to the participants who generously gave their time and insights - this research would not have been possible without them.

Finally, to everyone who played even the smallest part in supporting this research - thank you.

Dedicated to my family.

Abbreviatons

HCI	Human-Computer Interaction
CMC	Computer-Mediated Communication
CSCW	Computer-Supported Cooperative Work
ASGPI	Asynchronous, Semi-Guided, Professional Introduction
TDS	Team Diagnostic Survey
ICSI	Interpersonal Communication Satisfaction Inventory
RTA	Reflexive Thematic Analysis
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
MST	Media Synchronicity Theory
SIPT	Social Information Processing Theory

Chapter 1

Introduction

1.1 Context & Motivation

In 2020, office lights around the world started being replaced by the glow of laptop screens. The COVID-19 pandemic forced an overnight shift from in-person meetings to virtual interactions. Countless individuals found that their daily team discussions and one-on-one meetings had shifted to video calls. This transition revealed both the promise and the pitfalls of remote communication. On one hand, working from home offered safety and flexibility; on the other, they often felt awkward, with forced conversations and weak interpersonal connection.

This scenario was far from unique. At the height of the pandemic, the majority of workplace meetings and tasks migrated to the online environment, where countries have seen close to 70% of full-time positions switch to working from home (J. et al., 2022). Video conferencing usage became unavoidable, with platforms, for example Zoom, going from 10 million daily meeting participants in December 2019 to over 300 million by April 2020 (Karl et al., 2022). Similar surges were seen with platforms like Google Meet and Microsoft Teams (Hacker et al., 2020). This sharp and sustained increase in remote work adoption is illustrated in Figure 1.1. No longer having to commute each day to work was a welcome change, and appealed to many people, who preferred working from the comfort of their own home, and saving time and allowing for a more flexible schedule. It became easier to attend meetings, organise schedules, and manage personal tasks in day-to-day living. This flexibility was widely appreciated, often enabled by simple home-office setups and informal workwear. However, the transition was not without difficulties. Everyone had to adapt quickly to fully online collaboration, learning to use new tools (collaborative platforms) and developing new norms for virtual etiquette (Waizenegger et al., 2020). Miscommunications occasionally arose in chats or video calls, and it took great team effort to keep everyone on the same page. Research explored the absence of in-person contact, which sometimes made it harder

to feel connected to colleagues, highlighting how much people normally rely on hallway conversations and face-to-face cues. This period underscored that while remote work offers remarkable flexibility, it also requires deliberate adjustments to preserve team cohesion and effective communication (Whillans et al., 2021; Bailenson, 2021). Yet, despite this widespread shift and its documented challenges, existing communication tools and meeting norms have not evolved sufficiently to support more natural, engaging, or equitable one-on-one video interactions. This thesis addresses that unmet need – to explore how thoughtful design can actively shape the quality of remote communication, rather than passively adapt to its limitations.

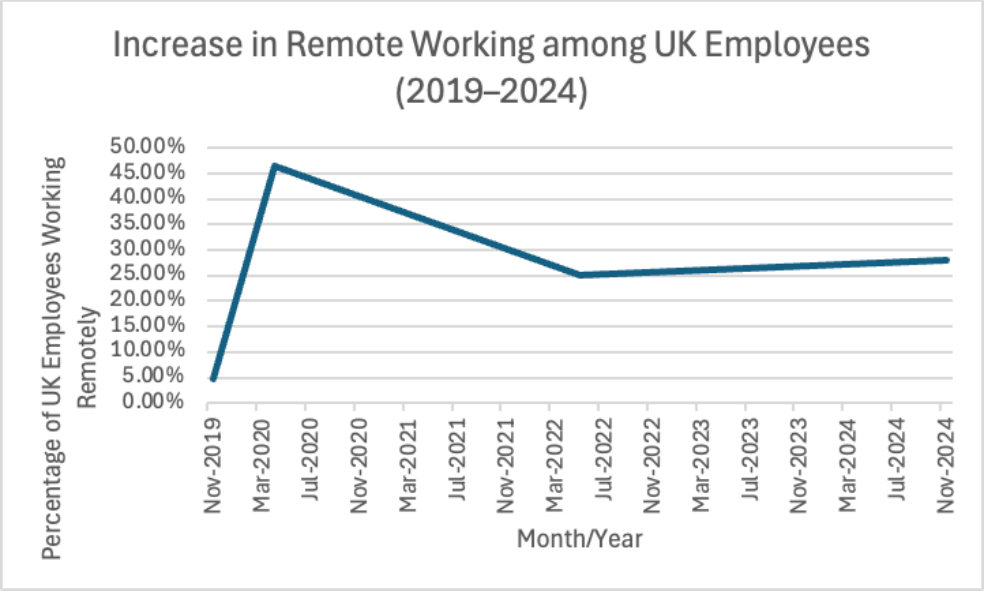

FIGURE 1.1: Increase in remote working among UK employees from 2019 to 2024, based on ONS data. The COVID-19 pandemic prompted a sharp increase in remote work, which has since stabilised at a much higher level than before the pandemic. Globally, 91% of workers report a positive view of remote work, underscoring the enduring appeal and acceptance of flexible working arrangements (Hooson, 2025; Buffer, 2023).

However, what began as an emergency workaround has since become a preferred mode of work for many. Despite the rapid adoption of online collaboration, which seemed rather urgent but which later became indispensable, even as offices reopen, organisations have embraced remote and hybrid work models. One analysis predicts that only 25% of business meetings would be conducted in person by early 2025 (Standaert et al., 2021). This widespread adoption of virtual meetings, born of necessity, became the motivation for the present research. In response to the challenges inherent in screen-mediated communication, this work was motivated by the idea of how it might be possible to improve video-based meetings, especially the intimate one-on-one (dyadic) meetings that form the backbone of collaboration and mentoring.

1.2 Why Does this Transition into the Virtual Matter?

Remote work and virtual meetings are now fixtures across technology companies, academic collaborations, and even healthcare consultations. Ensuring these meetings are effective is critical for productivity, innovation, and relationship-building. However, the move to remote collaboration has surfaced a number of persistent communication challenges that are now widely recognised in both academic literature and workplace practice. Key issues observed in video-based meetings include:

- **Disengagement** - It is easier for participants to lose focus or multitask during virtual meetings. Researchers have found that people feel less motivated to engage in remote meetings compared to in-person sessions (Cao et al., 2021). Multitasking is common – one study noted about 30% of videoconference meetings involved attendees concurrently sending emails (Cao et al., 2021). This reduced attention, often manifested and termed as "Zoom Fatigue" or burnout from continuous video calls (Beyea et al., 2025), undermines the quality of discussion and decision-making.

- **Conversational Imbalance** - In video calls, subtle turn-taking cues and body language are diminished, which can lead to one person unintentionally dominating the conversation or frequent interruptions (Bailenson, 2021). The flow of dialogue in dyadic calls can become uneven: participants might talk over each other due to slight audio lag, or long awkward pauses may emerge when both hesitate to speak. Such imbalance not only impedes information exchange but can also leave one party feeling unheard or frustrated. Despite the widespread adoption of video conferencing platforms, most still lack built-in mechanisms to monitor or gently correct conversational imbalances in real time, such as speaking dominance or interruptions (Iijima et al., 2025). This often leaves such issues unaddressed during meetings.

- **Lack of Trust and Rapport** - Building trust is harder when colleagues or partners interact through a screen, especially if they have never met in person. In traditional face-to-face meetings, small talk and body language help establish rapport (a sense of mutual understanding) quickly. In contrast, virtual dyadic meetings often start off impersonal and strictly task-focused, which can slow down trust development (Morrison-Smith and Ruiz, 2020). Studies have noted that higher "virtuality" (greater reliance on virtual communication) correlates with lower initial trust among team members (Jarvenpaa and Leidner, 1999). This lack of early trust can manifest as guarded communication, reduced information sharing, and a general sense of interpersonal distance during meetings.

- **No Structured Feedback Mechanisms** - In an in-person meeting, participants receive continuous informal feedback through nods, eye contact, or side comments,

and a meeting facilitator can intervene if the discussion goes off-track. In virtual meetings, many of these feedback channels are absent or muted. There is typically no real-time feedback on how the meeting is going beyond what each participant subjectively feels. For instance, someone who talks too much might not realise it, and someone who is lost or confused has limited ways to signal that without disrupting the meeting. The absence of a structured feedback loop means that issues like disengagement or imbalance are often recognised only after the meeting (if at all), rather than being addressed during the conversation.

While these issues affect all forms of virtual communication, they are especially problematic in dyadic meetings, where there are fewer participants to naturally regulate flow, provide social cues, or recover from imbalance. Yet much of the existing research and tool design has focused on group meetings, leaving one-on-one video conversations comparatively underexplored. These challenges highlight why improving virtual meetings matters. With remote collaboration here to stay across diverse domains – from software development teams brainstorming new features, to researchers discussing data, to doctors consulting with patients online – there is a pressing need to make video meetings more engaging, balanced, and trust-conducive. The core problem addressed in this thesis is how to mitigate the inherent limitations of video-based communication - such as reduced social presence, turn-taking imbalance, and low conversational awareness - so that one-on-one remote meetings can be as effective and satisfying as their face-to-face counterparts. Particular attention is given to how these challenges differ depending on familiarity between participants.

1.3 Governing Stance: Designing for the Triangular State of Team Dynamics

This thesis adopts a design-oriented governing stance, referred to here as the triangular state of team dynamics. This stance is introduced to conceptualise effective collaboration in video-based dyadic meetings as being sustained through three mutually reinforcing elements: trust, team effectiveness, and team satisfaction. These three elements are treated as mutually reinforcing. Firstly, trust supports willingness to share information, ask questions, and be vulnerable in uncertainty. Secondly, team effectiveness reflects the team's ability to coordinate, progress through tasks, and reach shared outcomes. Finally, team satisfaction captures the perceived quality of the interaction, including comfort, fairness, and willingness to collaborate again. In dyadic video meetings, where turn-taking cues are reduced and interpersonal context is limited, weaknesses in any one element can destabilise the others. As such, this thesis treats the triangle as the governing lens through which interventions are motivated, designed, and evaluated.

The triangular state of team dynamics functions as a governing design and evaluation framework rather than as a predictive psychological theory, specifying the interaction outcomes that the interventions are designed to support and test. It allows multiple psychological perspectives to be selectively integrated without committing to a single explanatory model of behaviour. It specifies what successful interaction means in dyadic video meetings, namely the joint preservation of trust, team effectiveness, and team satisfaction. To justify how specific interventions can support this state, the thesis selectively foregrounds a small set of psychological perspectives that explain why particular mechanisms should be effective. Common Ground Theory and psychological safety are used to explain how early information exchange can reduce uncertainty and accelerate trust in unfamiliar dyads, motivating pre-meeting scaffolding (Clark and Brennan, 1991). Cognitive Load Theory and self-regulation explain how disrupted turn-taking cues and imbalance increase attentional demand during live interaction, motivating in-meeting feedback mechanisms (Sweller, 2020; van Bruggen et al., 2002). Psychological safety in particular operates as a cross-cutting condition, explaining why feedback must remain subtle and non-evaluative to avoid undermining trust or satisfaction (Edmondson, 1999), whereas self-regulation explains how individuals adjust their behaviour in response to engagement cues during live interaction. Other theories discussed later in the thesis, including Social Information Processing Theory (Walther, 1996) and Media Synchronicity Theory (Dennis et al., 2008), are treated as contextual or explanatory rather than governing, and are used only to contextualise the communication environment and interpret findings, rather than to justify the intervention mechanisms.

To avoid conceptual overlap, this thesis distinguishes Social Information Processing Theory from self-regulation. Social Information Processing Theory is used to explain how participants in cue-reduced environments form impressions and adapt interaction strategies over time, particularly when engagement must be inferred rather than directly perceived. It therefore supports interpretation of why dyadic video interaction can feel unstable, why engagement cues are misread, and why adaptation pressure emerges when non-verbal grounding signals are limited. However, Social Information Processing Theory does not, on its own, explain how participants regulate behaviour moment by moment while speaking, listening, and coordinating turns under attentional constraint. For that purpose, the synchronous strand is framed through self-regulation under the Cognitive Load theory, in which feedback functions as an external awareness scaffold that helps participants notice and correct imbalances without diverting attention from the task or undermining interactional comfort.

Within this worldview, technology is not assumed to be a neutral channel. Instead, interface structure and meeting scaffolding are treated as mechanisms that can shape the conditions under which trust is established, effectiveness is achieved, and satisfaction is

maintained. The thesis therefore investigates how deliberately designed meeting structures can support the triangular state across different phases of a meeting lifecycle. The triangular state of team dynamics introduced here provides the unifying conceptual lens for the entire thesis. The empirical studies that follow are designed as complementary tests of this stance, and the extent to which it is supported, nuanced, or limited by the findings is explicitly synthesised and resolved in Chapter 5.

1.3.1 Foreground and Background Theories

The triangular state provides the governing stance that organises the thesis and defines what "improvement" means in dyadic video interaction, while selected psychological theories are foregrounded to justify how specific interventions can support this state. Background theories are used to explain why particular mechanisms should influence one or more elements of the triangle. Two foregrounded psychological anchors are used to link the interventions to the governing stance.

First, for unfamiliar dyads, the thesis draws on common ground and related work in Computer-Mediated Communication (CMC) to argue that pre-meeting knowledge exchange can reduce uncertainty and accelerate early trust development. This motivates an asynchronous intervention that acts before a first meeting begins.

Second, for familiar dyads, the thesis draws on cognitive load and self-regulation perspectives to argue that conversational imbalance and disrupted turn-taking increase attentional demands and reduce conversational control, which can erode both perceived effectiveness and satisfaction. This motivates an in-meeting feedback intervention designed to support awareness and behavioural adjustment with minimal disruption.

Importantly, this thesis does not treat all theories discussed in the literature as equally central to intervention design. Theories such as Social Information Processing Theory and Media Synchronicity Theory explain how communication unfolds under mediated conditions, but are limited in their ability to justify short-horizon, phase-specific interventions in dyadic meetings. They therefore serve as background context rather than as primary design drivers. By contrast, Common Ground and Cognitive Load theories explicitly address the psychological constraints that the proposed interventions are designed to alter, while psychological safety and self-regulation explain why intervention subtlety is necessary to preserve trust and satisfaction within the triangular state.

To maintain a clear line of argument, the thesis concentrates psychological explanation in a small number of foregrounded mechanisms, namely Common Ground Theory under psychologically-safe pre-meeting disclosure, and self-regulation under Cognitive Load, while treating broader CMC theories as contextual framing rather than parallel explanatory accounts.

1.4 Proposed Solutions

This thesis adopts a structured, solution-oriented approach to support for better interaction in video-based dyadic meetings by introducing and evaluating targeted interventions. It examines both asynchronous strategies for unfamiliar dyads and synchronous frameworks for familiar dyads. The central research question guiding this work is:

How to design for the triangular state of team dynamics in video meetings: trust, team effectiveness, and team satisfaction, through structured interventions that support collaboration across pre-meeting and in-meeting phases, while accounting for participant familiarity?

This thesis examines two intervention points in the meeting lifecycle. First, it evaluates whether pre-meeting Asynchronous, Semi-Guided, Professional Introductions (ASGPI) scaffolding can establish psychologically-safe common ground that accelerates early trust formation in unfamiliar dyads, thereby improving the triangular state at meeting onset. Second, it evaluates whether in-meeting engagement feedback can support self-regulation under cognitive load in familiar dyads, thereby protecting effectiveness and satisfaction when turn-taking cues are limited. More broadly, this thesis investigates how to find ways to make two-person video calls more engaging, equitable, and trusting by introducing purposeful structures around the meeting. The following two complementary intervention strategies are at the heart of this investigation:

1. **Asynchronous Pre-Meeting Introductions:** Before a virtual meeting even begins, is it possible to set the stage for better interaction? This work proposes using Asynchronous Semi-Guided Professional Introductions (ASGPIs) – essentially, short introduction recordings or written bios that participants exchange ahead of their first meeting. For example, two colleagues scheduled to meet for the first time would each share a brief video or message introducing themselves, their role, and perhaps their goals for the meeting. The thesis posits that such pre-meeting introductions can act as an ice-breaker, helping establish a baseline of familiarity and trust before the live conversation. While prior work has examined long-term team-building or onboarding in remote settings, little attention has been paid to lightweight, asynchronous techniques for warming up one-on-one meetings before they begin - a moment often left unstructured and prone to initial awkwardness. By reducing the ”initial awkwardness” of jumping straight into a call with a stranger, ASGPIs may lead to warmer, more open communication once the meeting starts. Within the governing stance, ASGPI is treated as a test of whether common ground-building before a first meeting can measurably

strengthen the trust corner of the triangle, with downstream effects on effectiveness and satisfaction, hence ensuring psychological safety. From a theoretical perspective, ASGPIs operationalise Common Ground Theory under conditions of unfamiliarity, testing whether early, low-pressure information exchange can strengthen trust and psychological safety within the triangular state. Media Synchronicity Theory is retained as a contextual explanation of why asynchronous, low-synchronicity communication is better suited to early sense-making and relationship grounding than live interaction, rather than as a primary basis for intervention design.

2. **Synchronous In-Meeting Engagement Feedback:** During the live video meeting, is it possible to provide participants with feedback to guide better communication in real time? This work explores the use of an engagement feedback system that monitors conversation dynamics (such as speaking time, interruptions, and pause lengths) and provides unobtrusive, instant feedback to both participants. The video call is augmented by a subtle facilitator that alerts users to potential issues – for instance, if one person has been speaking 80% of the time or if interruptions have spiked – allowing them to self-correct. By receiving gentle nudges or visual cues about these metrics, participants can adjust their behaviour on the fly (i.e. one might realise they should let the other speak more). Prior work in the fields of Human-Computer Interaction (HCI) and Computer-Mediated Communication CMC suggests that such real-time cues can nudge groups toward more balanced participation (DiMicco et al., 2004), and this thesis extends that concept to one-on-one meetings. The focus is on keeping feedback non-disruptive – enhancing awareness without diverting attention – so that the natural flow of conversation is maintained while improvements occur in the background. Within the governing stance, real-time engagement feedback is treated as a test of whether supporting self-regulation under cognitive load can reduce imbalance and improve perceived effectiveness and satisfaction without disrupting conversational flow. From a psychological perspective, this intervention operationalises Cognitive Load Theory and self-regulation by externalising conversational dynamics that are otherwise difficult to monitor in real-time, while remaining non-evaluative in order to avoid introducing additional social pressure. Studies 2 and 3 hence could be framed more explicitly as self-regulation systems in which real-time visual feedback supports in the moment behavioural control under Cognitive Load, with Social Information Processing Theory retained as contextual explanation of why cue scarcity creates adaptation pressure rather than as a primary basis for intervention design.

Together, these two interventions offer a structured answer to the shortcomings outlined in Section 1.2. They encompass the video meeting timeline: ASGPIs improve pre-meeting conditions to facilitate trust and comfort, while real-time feedback on conversational metrics enhances in-meeting responsiveness and balance. Both are designed to respect the natural order of conversation while embedding just enough structure to steer interaction towards greater trust-building, perceived effectiveness and satisfaction. The methodological scope, baselines, and resulting constraints on inference are stated explicitly in the following section. The following section clarifies the methodological vocabulary used throughout the thesis to describe design choices, rather than introducing additional experimental conditions.

1.5 Design Scope, Baselines, and Feasibility Framing

This thesis is structured as a sequence of targeted intervention studies and feasibility evaluations, rather than as a single fully-factorial experiment. Each intervention is tested in the context for which it is intended. The ASGPI intervention is evaluated in unfamiliar dyads because pre-meeting introductions are designed to address first-meeting uncertainty, and their purpose is undermined when dyads are already familiar. Conversely, the engagement-metrics feedback intervention is evaluated in familiar dyads because unfamiliar dyads introduce additional variability in conversational behaviour, including differences in willingness to interrupt, initial caution, and rapid comfort changes across meetings, which would confound behavioural interpretation of feedback effects.

These scoping decisions mean that the thesis does not pursue a complete 2×2 factorial crossing familiarity (unfamiliar versus familiar dyads) with intervention presence (baseline versus intervention). Baselines are therefore operationalised within each strand rather than universally, i.e. a comparator condition defined separately for each intervention context. For the synchronous strand, Meeting 1 without feedback provides a structured within-dyad comparator for Meeting 2 with feedback, while recognising that a prompted task-based conversation is not identical to everyday interaction. For the asynchronous strand, the baseline is a "cold start" first meeting without pre-meeting introductions. Consequently, the thesis does not include a universal "no-intervention" comparator that spans both familiarity contexts. This trade-off prioritises mechanism interpretability and feasibility within each intended context, but it necessarily limits causal completeness, including the ability to estimate familiarity $\times$ intervention interactions within a single unified design.

Making these concepts explicit clarifies the specific forms of causal contrast that are, and are not, estimated in the studies that follow.

1.5.1 Methodological Concepts Used in the Evaluation Design

Throughout this thesis, four methodological concepts are used to describe the evaluation design choices: baseline conditions, within-dyad designs, between-dyad designs, and factorial (2×2) designs. A baseline condition refers to a comparator in which an intervention is absent, used to estimate change attributable to the intervention relative to a defined reference context. A within-dyad design refers to comparing conditions within the same dyad across time or sessions, which increases sensitivity to change by controlling for stable interpersonal differences, but introduces risks of order effects and learning. A between-dyad design refers to comparing different dyads assigned to different conditions, which avoids carryover but typically requires larger samples to manage interpersonal variability. A 2×2 factorial design crosses two independent factors simultaneously in this problem space - participant familiarity (unfamiliar versus familiar) by intervention presence (absent versus present) - enabling estimation of main effects and interaction effects between factors. This thesis does not implement that full factorial crossing - instead, it uses strand-specific baselines and context-matched evaluation to support feasibility and mechanism clarity. These concepts frame the design compromises made in this feasibility-focused body of work and clarify which causal contrasts are estimated, and which remain out of scope, in the resulting evidence.

1.5.2 Rationale for Dyads, Measurement Suitability, and Scalability Limits

A dyadic unit was selected as a deliberate reductionist design choice. Dyads represent the minimal unit in which interpersonal trust, conversational coordination, and mutual regulation must be established without delegation, coalition formation, or subgroup structure. This minimal structure is analytically valuable at a feasibility stage because it reduces social degrees of freedom and increases interpretability of mechanism level effects, i.e. whether a given scaffold measurably alters awareness, behaviour, or perceived interaction quality under constrained conditions. Classical sociological accounts also characterise dyads as distinct from larger group forms because they are structurally fragile and highly responsive to changes in participation, which supports their use as a sensitive framing for early intervention effects (Simmel, 1950). Dyads are also common in everyday and organisational settings, including mentoring, supervision, onboarding, and peer collaboration, which makes them a practically relevant unit for studying video-mediated interaction (Bakeman and Beck, 1974).

However, this dyadic focus introduces important measurement considerations. Several constructs used to evaluate the governing triangular state, particularly perceived team effectiveness and satisfaction, originate in broader team science traditions where measures assume multi-person coordination, distributed roles, and group level dynamics. For example, intrinsic factors of team collaboration, measured by questionnaires

such as the Team Diagnostic Survey (TDS) were originally developed for organisational teams and diagnostic assessment of enabling conditions in larger units, rather than exclusively for two-person interaction (Wageman et al., 2005). In the present thesis, such measures are used in a scoped manner, prioritising constructs that remain meaningful in a two-person setting, i.e. perceived effectiveness of joint task progress, satisfaction with interaction quality, and trust in the partner. Where items implicitly presuppose multi-person features, such as within-team role differentiation or subgroup coordination demands, these are treated as conceptually informative but not fully instantiated in the dyadic case. Consequently, conclusions drawn from these measures are framed as dyad-appropriate indicators of the triangular state rather than as complete representations of broader team functioning.

Critically, dyadic designs cannot capture several interactional phenomena that become central as meetings scale beyond two participants. In multi-party settings, coordination includes competition for the conversational floor, overlapping talk across more than two streams, subgroup emergence, shifting attention, and more complex timing and delay effects that shape turn-taking and perceived responsiveness in mediated interaction (Bailenson, 2021; Masters and MacDonald, 2025). These factors introduce additional sources of variance that are intentionally placed in the present feasibility-focused body of work. The thesis therefore treats scalability as an open design and evaluation question. The dyadic results establish that the proposed scaffolds can operate as intended within the simplest social configuration, but they do not yet demonstrate robustness under multi-party conditions, nor do they quantify how feedback legibility, fairness perceptions, or behavioural adaptation change as the number of participants increases.

1.5.3 Measurement Reliability and Justification of Instrument Choices

Because the thesis is feasibility/mechanism-oriented, measurement selection prioritises interpretability, construct coverage, and triangulation across behavioural and perceptual indicators, rather than relying on a single definitive instrument. Nevertheless, the use of adapted questionnaires and threshold-based behavioural metrics introduces reliability considerations that constrain inference.

First, several perceptual constructs are assessed using established self-report instruments or scoped adaptations of existing scales. Using established measures increases conceptual grounding, but transferring instruments developed for larger teams or different contexts into dyadic video interaction can reduce measurement fit and internal consistency of some subscales. Where measures were adapted, the purpose was to increase contextual relevance and reduce participant burden in short sessions, but this adaptation may reduce comparability with prior work and can weaken reliability if items do not function identically in the new context.

Second, behavioural measures such as interruptions, pauses, and speaking balance rely on operational thresholds. Fixed thresholds increase repeatability across participants and sessions, but they can be sensitive to conversational style, audio latency, and task structure. This means that measurement reliability is strongest for within-study comparisons under consistent instrumentation, and weaker for claims of absolute conversational quality across contexts.

To mitigate these risks, this body of work combines multiple strategies: consistent task structure and administration procedures across conditions, comparable meeting durations within each strand, and mixed-method triangulation in which behavioural measures are interpreted alongside participant reports rather than treated as standalone ground truth. The resulting evidence is therefore framed as mechanism responsiveness under controlled conditions, rather than as definitive estimates of stable real-world effects. Future work should formalise reliability assessment of adapted scales in dyadic video contexts and test alternative thresholding strategies, including personalised or adaptive calibration.

1.5.4 Feasibility Positioning and Implications for Inference

More broadly, following the Medical Research Council (Skivington et al., 2024) framing for complex interventions (particularly the emphasis on iterative development, feasibility, and mechanism testing prior to definitive effectiveness trials), the contribution is positioned as feasibility-supported and mechanism-oriented: it provides evidence that targeted meeting scaffolds can improve trust, effectiveness, and satisfaction in their intended contexts, while explicitly constraining claims about cross-context generality. A full factorial evaluation would be required to quantify generalisation across familiarity contexts and to formally estimate familiarity $\times$ intervention interaction effects, which are not identified in the present body of work.

This design reduces confounding from first-contact uncertainty in the synchronous strand, but it limits inference about interaction effects between familiarity and feedback, and about how feedback would operate during early relationship formation.

1.6 Research Contribution

Across both studies, contributions are framed in terms of how design can support the triangular state of team dynamics in dyadic video meetings. The ASGPI work primarily targets early trust formation in unfamiliar dyads, while the engagement feedback work targets the maintenance of effectiveness and satisfaction during live interaction in familiar dyads.

Building on the structured interventions introduced in the previous section, this thesis contributes a two-fold solution to the persistent challenges of video-based dyadic communication. By evaluating asynchronous and synchronous strategies in their intended familiarity contexts, the thesis provides feasibility-supported evidence that communication quality, behavioural engagement, and interpersonal connection can be actively shaped through purposeful design. These contributions are grounded in real-world testing and provide actionable insights for improving one-on-one virtual meetings - offering concrete answers to long-standing questions in HCI about how technology can mediate and enhance human interaction. This section highlights the tangible value of the interventions. Specifically, it focuses on two overlooked yet critical moments in the meeting timeline: (1) the phase before a first-time virtual meeting between unfamiliar dyads, and (2) the live conversational dynamics between familiar dyads. In both cases, the research foregrounds the importance of familiarity - or its absence - in shaping trust, effectiveness, and satisfaction. The research contributions are structured around these two core contexts, each addressing specific challenges identified in Section 1.2:

- **Before-Meeting Interventions for Unfamiliar Dyads:** How do ASGPIs influence the early dynamics of a new virtual meeting between two people? This part of the research delves into questions such as: Do participants feel more at ease and trusting when they have exchanged introductions beforehand? Does an asynchronous introduction lead to measurably better rapport or collaboration once the meeting begins? This research responds to the gap in literature on how trust and rapport are built in the earliest moments of virtual dyadic meetings. Existing work tends to focus on long-term team-building or structured onboarding, overlooking what happens before the first meeting. This thesis makes a distinct and empirically validated contribution by isolating a low-effort, scalable mechanism - ASGPIs - specifically designed to address this gap. The contribution lies not only in (1) the manufacturing, evaluation and interactional implications of building ASGPIs, but also in (2) demonstrating their measurable impact on participant comfort, early trust, and conversational fluidity, and (3) the development and application of a professional familiarity questionnaire tailored to short-term dyadic interactions. This original instrument enables a more precise assessment of perceived professional familiarity and complements existing metrics for trust and effectiveness. Taken together, these contributions help resolve the broader problem of impersonal, transactional online meetings by offering an approach that is lightweight, adaptable, and applicable to real-world contexts such as remote hiring and cross-organisational collaboration. Unlike existing methods that rely on institutional onboarding or facilitator mediation, this approach empowers individuals directly - making it both more accessible and more flexible than prior strategies.

- **In-Meeting Interventions Strategies for Familiar Dyads:** How does real-time feedback on engagement metrics affect the behaviour and experience of participants during a video call? In this portion, the thesis examines questions such as: Can live feedback reduce extreme imbalances in speaking time? Will participants alter their interaction style (i.e. interrupt less, listen more) if they are made aware of these patterns during the meeting? Does receiving such feedback improve their overall satisfaction with the conversation? While conversational imbalance and disengagement are well-documented issues in virtual meetings, existing systems provide little to no real-time support for managing these dynamics in one-on-one settings. Most previous interventions focus on turn-taking strategies, group meetings or post-hoc analysis. This thesis addresses a critical and under-explored problem by developing and evaluating a live feedback mechanism tailored specifically for dyadic interactions. The contribution is threefold: (1) it introduces a novel feedback design that is subtle enough to preserve conversational flow while still promoting behavioural self-awareness; (2) it provides empirical evidence that such feedback can meaningfully improve speaking balance, reduce interruptions, manage pauses and enhance overall satisfaction; (3) it proposes a novel framework of defining and operationalising a set of engagement metrics as measurable and actionable conversational dynamics that reflect dialogue efficiency and balance. In contrast to static dashboard visualisations or explicit moderator roles found in prior research, the proposed system quietly augments interaction without disrupting it - offering a more sustainable and user-friendly solution to mid-meeting imbalance, and contributing a structured foundation for future feedback-driven communication systems.

Together, these studies advance the state of the art in three key ways:

1. They directly address distinct, under-served stages of the video meeting lifecycle – before and during the meeting – offering a structured and holistic approach to solving interpersonal challenges that are usually treated in isolation.

2. They provide empirical evidence, under targeted baselines, that practical, minimal-effort interventions can improve key outcomes relative to the comparators used in this sequence of studies or assumptions around self-regulation and self-awareness in virtual settings.

3. They contribute methodological and design insights for developing future tools that seek to nudge interaction without overwhelming the user, helping establish new design patterns for engagement-aware communication in HCI.

Cumulatively, this work provides evidence suggesting not only that better outcomes are possible, but how to achieve them using thoughtful, targeted interventions. It

provides a basis for future factorial or field evaluation for others in HCI and CMC to build upon - one that bridges the gap between abstract design ideals and actionable, evidence-based communication support. The following publications are based on the work presented in this thesis:

- Muresan, G.C., Mititelu, S. and Andres, J., 2024. "Should I Introduce myself?": Asynchronous semi-guided professional introductions for enhanced perceived team effectiveness in new virtual dyadic teams. International Journal of Human-Computer Studies, 188, p.103279. (Muresan et al., 2024) (Presented in Chapter 3)
- "Let Me Talk!" - Exploring Feedback Mechanisms in Video-Based Dyadic Communication: Introducing Engagement Metrics to Analyse Conversational Dynamics and Improve Collaboration, Satisfaction, and Behavioural Awareness Among Familiar Pairs (Under review and presented in Chapter 4)
- Schraefel, M.C., Muresan, G.C. and Hekler, E., 2021. Experiment in a box (XB): an interactive technology framework for sustainable health practices. Frontiers in Computer Science, 3, p.661890. (schraefel et al., 2021) (Related to broader work, not directly presented in the thesis)

1.7 Thesis Structure

This thesis is organised into chapters that mirror the progression of the research inquiry:

- **Chapter 2 – Literature Review:** This chapter surveys the relevant literature and theoretical background underpinning the thesis. It covers topics such as the rise of remote work and previous studies on virtual meeting effectiveness, theories of Computer-Mediated Communication (i.e. Media Synchronicity Theory), trust development in virtual teams, and conversational dynamics in online settings. By reviewing prior work on meeting science and collaborative systems, Chapter 2 identifies gaps that the current research aims to fill and solidifies the rationale for the proposed interventions.
- **Chapter 3 – Asynchronous Introductions Study:** This chapter details the first core study of the thesis, focusing on Asynchronous Semi-Guided Professional Introductions. It begins with a targeted review of related work on trust-building and onboarding in remote settings, highlighting the need for lightweight, pre-meeting interventions in unfamiliar dyads. It describes the design and implementation of the ASGPI intervention, outlines the experimental setup and evaluation methods, presents the results and a discussion of the key findings. The chapter

explores how asynchronous familiarity-building affects interpersonal trust and conversational ease in newly formed dyads.

- **Chapter 4 – Synchronous Feedback Study:** This chapter presents the second major study, centred on real-time feedback using conversational engagement metrics. It opens with a focused review of related work on feedback systems and conversational dynamics in synchronous settings, framing the unique contribution of this work. The chapter describes the formal definition of engagement metrics, the design and implementation of a live engagement dashboard and investigates its effects on turn-taking behaviour, speaking balance, interruptions, pauses, and conversational satisfaction. The chapter analyses both behavioural outcomes and participants' experiences, contributing insights into how real-time systems can modulate interaction quality. The two studies presented in this chapter build upon each other and each lay out the foundational motivation, methodology, evaluation, results and discussion of key findings.
- **Chapter 5 - Conclusion:** The final chapter revisits the overarching research question and governing triangular stance introduced in Chapters 1 and 2, synthesises insights from both empirical studies, and explicitly resolves how the findings advance, nuance, or limit the proposed view of trust, effectiveness, and satisfaction in dyadic video meetings.

1.8 Summary

In summary, this thesis consolidates its core findings and validated strategies into four main takeaways:

- **Novel Strategies for Improving Virtual Meetings:** This thesis introduces two novel intervention techniques – asynchronous self-introductions and synchronous engagement feedback – designed for distinct phases of video-based meetings, offering a dual-phase perspective not previously explored in dyadic communication research. By devising these strategies and testing them in realistic scenarios, the research offers concrete methods to tackle common virtual meeting problems (i.e. awkward beginnings and uneven participation) and demonstrates their effectiveness. These strategies are novel in their dual focus on pre-meeting and in-meeting phases, providing a structured approach that has been largely absent from prior interventions targeting dyadic video communication.

- **Empirical Evidence on Trust-Building via ASGPIs:** Through the first study, the thesis provides empirical data showing that Asynchronous Semi-Guided Professional Introductions can significantly improve initial meeting dynamics. Participants who exchanged brief intro videos prior to a one-on-one meeting exhibited higher levels of early trust and comfort compared to those who met ”cold”. This finding advances understanding of how early rapport can be cultivated remotely, validating a practical approach for teams and organisations onboarding new members or clients in a virtual setting.

- **Real-Time Feedback for Balanced Engagement:** The second body of research contributes a validated design for a real-time engagement feedback system in video calls, along with evidence of its impact. It shows that giving meeting participants live metrics (like speaking time share and interruption alerts) can lead to more balanced conversations and improve participants' perceived fairness and satisfaction in the dialogue. This result advances the field of meeting science, highlighting how technology can play an active role as a mediator or coach in communications. The concept of an ”always-on” meeting facilitator is made tangible and evaluated, opening doors for more refined tools that enhance online collaboration.

- **Integration of Psychological Theory and Interaction Design:** By addressing trust and engagement - two traditionally human-centric facets of communication - through targeted technological interventions, this thesis bridges psychological theory and interaction design. This work draws on Common Ground Theory and psychological safety to justify structured pre-meeting introductions that reduce uncertainty and support early trust in unfamiliar dyads. It draws on Cognitive Load Theory and self-regulation to explain how turn-taking imbalance and cue disruption increase attentional demand during live interaction, motivating in-meeting feedback mechanisms. Psychological safety is therefore foregrounded in the asynchronous strand, where ASGPIs function as a low-pressure meta-meeting space supporting trust formation through controlled self-disclosure, while the synchronous engagement feedback system is instead framed around supporting self-regulation as a primary explanatory lens. The empirical findings demonstrate that carefully designed interventions can improve engagement without introducing additional social pressure, contributing both to theory and to practical guidance for designing more equitable and satisfying one-on-one video meetings.

The findings reported in the following chapters should be interpreted in light of the thesis' design constraints. Because the studies are targeted to the contexts for which each intervention is designed, the thesis does not estimate a full set of cross-context contrasts, i.e. it does not test the same intervention across both unfamiliar and familiar dyads within a single factorial structure. The contribution is therefore the strongest as

a set of mechanism-grounded, feasibility-informed results that motivate future work using broader baselines, alternative comparators, and factorial or field evaluations to quantify generality. Overall, the findings of this thesis advance knowledge in the domain of virtual meetings by demonstrating that the quality of video-based dyadic communication is not an immutable weakness of remote work. On the contrary, with thoughtful design, it is possible to add structure and support into video calls to make them more engaging, equitable, balanced and trust-rich. These contributions are timely as organisations worldwide continue to navigate the challenges of remote and hybrid work. By improving the understanding of how to enhance remote one-on-one meetings, the thesis ultimately helps pave the way for more effective and human-centred virtual collaboration in the future.

Chapter 2

Related Work

2.1 Introduction

The increasing reliance on video-based communication has transformed the way individuals interact in professional, educational, and social contexts. While remote meetings offer accessibility and flexibility, they also introduce significant barriers to engagement, conversational balance, and trust formation (Bailenson, 2021). These challenges are particularly pronounced in dyadic interactions, where the absence of non-verbal cues, disrupted conversational flow, and delayed feedback hinder natural engagement (Walther, 1996; Bos et al., 2002). To keep the review analytically consistent, this chapter treats engagement challenges in dyadic video meetings through three interdependent outcomes: trust, team effectiveness, and team satisfaction. In this thesis, a team refers to dyadic cooperation. Accordingly, the chapter is organised as a question-driven review, with explicit scope boundaries and a phase-based synthesis across out-of-meeting and in-meeting interventions. These outcomes are frequently addressed in prior work, but typically as separate evaluation targets, which makes it difficult to infer how design interventions influence the overall state of a dyadic meeting.

Consistent with the governing stance introduced in Chapter 1, this review does not treat all cited theories as equally-central to intervention design. Instead, psychological theories such as Common Ground Theory, Cognitive Load Theory, psychological safety and self-refgulation are used to explain why specific mechanisms are expected to influence trust, effectiveness, and satisfaction, while other CMC and HCI theories are reviewed here as contextual or explanatory accounts of mediated interaction.

This chapter synthesises research on engagement in virtual dyadic meetings by contrasting how asynchronous and synchronous communication conditions shape trust, team effectiveness, and team satisfaction, and by identifying where prior work provides fragmented rather than integrated guidance (Hrastinski, 2008). The discussion

begins with a broad examination of engagement challenges in video-based communication, before narrowing in on two distinct approaches for enhancing interaction: asynchronous strategies (i.e. structured pre-meeting interventions) and synchronous strategies (i.e. real-time engagement feedback). This analysis lays the groundwork for the thesis by surfacing underexplored challenges - particularly around trust formation, conversational balance, and live engagement awareness - that justify the structured interventions proposed in this thesis. It also prepares an explicit mapping from identified gaps to the research question, intervention design, and methodological choices introduced in Chapters 3 and 4. The next sections review research on these engagement challenges across both asynchronous and synchronous communication contexts, beginning with a focus on dyadic interaction and the impact of reduced non-verbal cues. In doing so, the chapter makes explicit how micro-level interaction phenomena, such as turn-taking disruption or cue loss, translate into these macro-level outcomes, which provides the rationale for the thesis interventions and their evaluation. This triangular framing also provides the evaluative structure through which the thesis findings are synthesised and resolved in Chapter 5.

2.1.1 Review Approach, Scope, and Selection Logic

This chapter is structured as a question-driven literature review designed to demonstrate systematic acquisition and critique of research at the forefront of HCI and CMC on engagement in video-based dyadic communication. To demonstrate systematic acquisition, the review specifies its temporal scope, data sources, screening logic, and inclusion and exclusion boundaries, then synthesises evidence through the triangular state across meeting phases. Rather than providing a broad survey of remote work or video conferencing in general, the review interrogates existing evidence through a single guiding question:

Review Question: How have prior systems and theories supported engagement in video-based dyadic meetings across out-of-meeting and in-meeting phases, and what gaps remain in designing interventions that jointly protect trust, team effectiveness, and team satisfaction under conditions of cue loss and varying familiarity?

The literature search covered mainly work published between 1990 and October 2025, capturing foundational theories in CMC alongside contemporary system and intervention research in HCI and Computer-Supported Cooperative Work (CSCW). Searches were iteratively updated to ensure inclusion of recent work on video-mediated interaction, self-disclosure, real-time feedback systems, and engagement metrics emerging in response to large-scale remote work adoption. To answer the question, the review was scoped to research relevant to dyadic video interaction and engagement support mechanisms, drawing from HCI, CMC, CSCW, meeting science, and conversational analysis.

The included literature was selected because it contributes at least one of the following: (1) empirical findings on engagement challenges in video-mediated interaction (including cue loss, latency, fatigue, and trust dynamics); (2) theoretical accounts that explain how communication timing and cue availability shape interaction outcomes, and (3) intervention-oriented systems that seek to support participation, conversational balance, or awareness of interaction dynamics. To support auditability, the selection logic below summarises how sources were identified, screened, and retained.

This review drew on peer-reviewed work indexed in ACM Digital Library, IEEE Xplore, and Google Scholar, alongside venue-led searching within CHI, CSCW, ICMI, TOCHI, and IJHCS, and closely-related meeting science outlets. Searches prioritised video-mediated interaction, dyadic or one-to-one settings, and engagement-relevant outcomes, namely trust, effectiveness, and satisfaction. Search queries were formulated to capture dyadic video interaction, engagement breakdowns, and intervention-oriented systems. Core queries included:

- (”video-mediated communication” or ”video meetings” or ”video conferencing”) and (”dyad” or ”one-to-one” or ”dyadic interaction”);
- (”asynchronous communication” or ”asynchronous video”) and (”pre-meeting introductions” or ”self-disclosure” or ”icebreaker activity”) and (”common ground” or ”familiarity” or ”trust” or ”psychological safety”) and (”first meeting”);
- (”real-time feedback” or ”interaction awareness” or ”engagement feedback”) and (”turn-taking” or ”participation balance” or ”interruptions”) and (”video meetings” or ”synchronous interaction”) and (”engagement” or ”interruptions” or ”verbal pauses” or ”speaking balance”).

These queries were adapted to database-specific syntax and supplemented with venue-led searches to ensure coverage of systems-oriented and design-led work that may not be consistently indexed through keyword search alone. Backward and forward citation tracing was used to identify foundational theory papers and highly-cited empirical work that structured subsequent lines of research. This review is systematic in its acquisition, screening, and analytic synthesis, but does not constitute a PRISMA-style (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) systematic review with formal quality scoring. Quality appraisal was conducted implicitly through venue selectivity, peer-review status, citation influence, and methodological relevance to dyadic video interaction, rather than through exclusion based on rigid quality thresholds. This approach is appropriate for an interdisciplinary HCI literature where theoretical, empirical, and design-led contributions are heterogeneous but jointly informative. This strategy ensured coverage of both foundational theory and contemporary intervention work, but it also revealed a recurring limitation across the

field, namely that many studies make strong claims about engagement while operationalising only one corner of the triangular state, which restricts comparability and makes trade-offs difficult to infer.

Eligibility criteria excludes work that, while related to remote communication, does not directly inform the design and evaluation of engagement interventions in dyadic video settings. Specifically, it excludes studies that focus exclusively on large-group meeting governance without implications for dyads, papers concerned solely with technical media optimisation without behavioural or experiential outcomes, and work on asynchronous collaboration that does not address the transition into or impact on live conversational engagement. Studies of immersive platforms such as Virtual Reality (VR) are included only where they clarify the role of non-verbal cue restoration or highlight why lightweight approaches for standard video calls remain necessary.

Records were screened by title and abstract for relevance to dyadic video interaction and engagement-related outcomes, then reviewed in full text when they contributed empirical evidence, theory, or intervention designs. Studies were included when they directly examined dyads or provided mechanisms and measures transferable to dyadic constraints. Studies were excluded when they focused on large-group governance without dyad-relevant mechanisms, addressed technical media optimisation without behavioural or experiential outcomes, or treated asynchronous collaboration as an endpoint rather than preparation for live engagement. The initial database and venue-led searches returned approximately 800 records. After title screening, approximately 500 records remained for review. Of these, approximately half were excluded due to lack of relevance to dyadic interaction, absence of behavioural or experiential outcomes, or focus on large-group governance without transferable mechanisms. The remaining papers were reviewed in full text, of which over 200 were retained as directly informing engagement breakdowns, theoretical framing, or intervention design in video-based dyadic communication. Additional foundational and highly-cited works were incorporated through backward and forward citation tracing, resulting in a total corpus of approximately 300 sources across the thesis.

Following full-text reviews, each retained study was analytically coded along a small number of factors derived from the review question and emerging patterns in the literature. Specifically, studies were coded by (1) meeting-phase addressed (out-of-meeting or in-meeting); (2) interaction scope (explicitly dyadic or mechanisms transferable to dyadic settings); (3) primary engagement focus (trust, team effectiveness, team satisfaction, or behavioural proxies such as turn-taking, interruptions, and pauses); and (4) contribution type (theoretical account, empirical analysis, or intervention-oriented system). This extraction enabled systematic comparison across heterogeneous literatures and supported the identification of recurring gaps, trade-offs, and phase-specific blind spots. These coded dimensions directly informed the organisation of the chapter and the mapping from prior work to the research questions, intervention designs,

and methodological choices developed in subsequent chapters. This analytic positioning also informs the empirical chapters, where qualitative findings are used to interpret intervention mechanisms and perceived effects, rather than to reconstruct task dynamics or conversational sequences in detail. Gaps were identified where clusters of studies populated only one coded factor - for example effectiveness without trust, or in-meeting support without out-of-meeting scaffolding - and these gaps are used to motivate the intervention rationale and study designs in Chapters 3 and 4.

Across the thesis, qualitative analysis is treated as interpretive rather than reconstructive. Where qualitative data is analysed in later chapters, this is undertaken using a thematic approach oriented toward participants' reported perceptions, interpretations, and sense-making, rather than toward micro-analytic reconstruction of interactional sequences. This stance aligns with Reflexive Thematic Analysis (RTA), which treats meaning as co-constructed through participant accounts and researcher interpretation, rather than as a direct record of behavioural events (Braun and Clarke, 2019; Clarke and Braun, 2017). Accordingly, qualitative analysis in this thesis is used to contextualise, explain, and qualify observed behavioural and perceptual effects, rather than to provide fine-grained accounts of turn-by-turn interaction or task execution. As a consequence, the thesis does not attempt a parallel qualitative analysis of task interaction itself (i.e. conversational sequence analysis or interactional coding of task performance), and instead focuses on how participants reflect on and interpret their engagement during and after the interaction.

Accordingly, the thesis does not utilise interaction-focused qualitative approaches such as conversation analysis or interaction analysis, which would require fine-grained transcription and sequential interpretation of task talk to explain how specific turns produced specific outcomes. Instead, the qualitative component is used to capture how participants interpreted their experience of engagement and feedback, and to explain why measured behavioural changes were experienced as helpful, stressful, or socially ambiguous. This division of labour positions behavioural measures as evidence of what changed, and RTA as evidence of how those changes were understood and evaluated by participants. Such approaches would be more appropriate for research questions focused on sequential organisation, repair mechanisms, or turn-by-turn coordination within task talk, particularly in studies seeking to explain how specific conversational moves produce specific outcomes.

The literature is synthesised through an analytic lens that treats trust, team effectiveness, and team satisfaction as an interdependent triangular state. This lens is used to (1) classify how different engagement breakdowns map onto different outcomes; (2) identify where prior work treats these outcomes in isolation; and (3) expose trade-offs introduced by attempted solutions. The review is then organised by meeting phase, distinguishing (1) out-of-meeting mechanisms that can shape first impressions and early common ground formation and ensuring psychological safety; and (2) in-meeting

mechanisms that can support behavioural self-regulation under cognitive load. This structure enables direct mapping from identified gaps to the two intervention strands evaluated in later chapters, namely ASGPIs as a structured pre-meeting mechanism and real-time engagement metrics as an in-meeting feedback mechanism.

Across these strands, the literature repeatedly demonstrates partial solutions to engagement breakdown, but no single approach systematically addresses how trust, effectiveness, and satisfaction are jointly shaped across meeting phases in dyadic video interaction.

2.2 The Role of Engagement in Video-Based Dyadic Meetings

2.2.1 Why Focus on Dyads?

This subsection justifies the dyad as the unit of analysis for the review question. The focus is restricted to dyadic meetings because the triangular state of team dynamics, trust, team effectiveness, and team satisfaction, is more tightly coupled in two-person interaction, where regulation and repair cannot be distributed across additional participants. This scoping decision enables later sections to evaluate whether phase-specific interventions can stabilise this coupled state under cue loss and varying familiarity. In communication research, dyads have long been recognised as the fundamental unit of social interaction (Berger and Calabrese, 1975; Argyle and Dean, 1965). Dyadic conversations, whether collaborative, instructional, or interpersonal, rely on reciprocal turn-taking, mutual understanding, and trust formation (Clark and Brennan, 1991). Unlike group discussions, where conversational responsibilities are distributed among multiple participants, dyads demand a higher degree of coordination between two individuals, making them particularly vulnerable to imbalances in engagement (Kraut et al., 1988). This vulnerability is consequential because dyadic imbalance propagates across the triangular state: dominance or withdrawal can reduce trust through perceived unfairness, reduce effectiveness through disrupted coordination, and reduce satisfaction by making interaction effortful.

The shift from face-to-face to virtual dyadic interactions has been widely studied, with findings indicating that digital environments disrupt the natural rhythm of dyadic exchanges (Sellen, 1995; Whittaker, 2003). Research in CMC suggests that virtual dyads face greater difficulty in building rapport, managing conversational balance, and maintaining engagement over time (Walther, 1992; Derks et al., 2008). These challenges are largely attributed to the lack of shared physical presence, which limits spontaneous social cues and implicit bonding mechanisms (Bos et al., 2002). Across this literature, dyadic disruption is typically evidenced through cue loss, altered pacing, and reduced rapport, but the outcomes are commonly measured separately, which limits

inference about whether a design improvement targeting one corner of the triangular state produces unintended costs in the others. Moreover, studies on trust in virtual teams highlight that dyadic interactions suffer from increased social inhibition and reduced self-disclosure, particularly depending on the level of participants' familiarity (Walther et al., 2005). Without structured support, virtual dyads are vulnerable to interaction breakdowns where one participant dominates and the other disengages, which can simultaneously destabilise trust, effectiveness, and satisfaction (Gibson and Cohen, 2003). However, much of the existing evidence reports these problems as parallel outcomes, for example trust deficits or participation imbalance, rather than as a coupled state within a single meeting episode. As a result, the literature provides limited guidance on what lightweight, phase-appropriate mechanisms can be introduced to stabilise dyadic engagement without increasing cognitive load or creating new social pressure. This gap motivates the thesis focus on structured interventions positioned at different points in the meeting lifecycle, out-of-meeting scaffolding to support early trust formation and in-meeting feedback to support behavioural self-regulation.

2.2.2 Engagement Challenges in Virtual Communication

This subsection synthesises empirical and theoretical work that identifies recurrent engagement breakdowns in video-based interaction. The review is organised around four challenge categories that recur across the literature, non-verbal cue loss, turn-taking disruption, cognitive overload, and trust deficits, and evaluates how each is linked to trust, effectiveness, and satisfaction. This structure enables comparison across studies and exposes where outcomes are examined in isolation rather than as a coupled interactional state.

Virtual communication presents several interrelated challenges that impact engagement, making it less natural, more cognitively demanding, and often less satisfying than in-person conversations (Sellen, 1995; Whittaker, 2003). These challenges stem from non-verbal communication loss, turn-taking rigidity, cognitive overload, and trust deficits, all of which influence how individuals navigate interactions in remote settings.

Disruption of Non-Verbal Communication

A fundamental barrier in video-based interaction is the disruption of non-verbal cues, which are central to conversational flow and engagement (Birdwhistell, 2010; Kendon, 1990). Face-to-face communication relies on subtle indicators such as facial expressions, microgestures, head nods, and gaze direction to establish social connection and speaker coordination (Argyle and Dean, 1965). However, video-based settings distort or eliminate many of these cues, making it difficult for participants to infer engagement levels or emotional states (Croes et al., 2016; Aharony, 2006). Across this body of work, non-verbal cue disruption is primarily operationalised through gaze misalignment, reduced

facial visibility, and delayed gesture timing. For example, Vertegaal (1999) manipulated camera alignment to examine perceived eye contact and social presence, while Oh et al. (2018) focused on gesture–speech synchrony and its effect on interpersonal connection. Consistent with earlier sections, these studies consistently demonstrate perceptual effects on trust and social presence, but do not examine whether restoring these cues alters turn-taking behaviour, speaking balance, or interaction satisfaction within the same meeting episode. Furthermore, gaze and gesture studies often demonstrate reliable effects on social presence or perceived connection, but do not test whether these perceptual gains improve coordination quality or interaction satisfaction in the same meeting, leaving open whether cue restoration stabilises the triangular state or simply strengthens one corner.

Several studies highlight how mutual gaze awareness is significantly reduced in video conferencing platforms, disrupting synchrony and interpersonal bonding (Vertegaal, 1999; Oh et al., 2018). This disruption is further enhanced by camera misalignment issues, where participants appear to be looking at their screens rather than at each other, weakening eye-contact reciprocity and engagement perceptions (Bailenson, 2021; Kum et al., 2024). Research suggests that video-based interactions lack the immediacy and warmth of in-person dialogue, leading to lower trust development and weaker social bonds (Bos et al., 2002; Walther, 1996), with indirect consequences for satisfaction and coordination. These studies therefore explain why trust erodes, but they rarely examine whether trust erosion is mediated by specific interaction breakdowns, such as interruption cascades or reduced backchanneling, which limits design guidance about what to change during the meeting. In response to the lack of non-verbal cues, participants in virtual communication settings often adopt additional behaviours. One adaptation involves exaggerated facial expressions, head movements, and deliberate verbal affirmations to signal attentiveness and engagement (Derks et al., 2008; Tramontano et al., 2021). Another common strategy is over-reliance on verbal cues, where individuals consciously articulate agreement or hesitation instead of using subtle facial or gestural indicators. While these adaptations help to partially mitigate the absence of natural social signals, they place additional cognitive demands on participants, making virtual conversations more mentally challenging than face-to-face interactions (Bailenson, 2021). Across studies, non-verbal cue loss is most consistently linked to reduced trust and social presence, whereas its downstream impact on effectiveness and satisfaction is often implied rather than directly measured, leaving uncertainty about how design mitigations that target cue restoration translate into joint changes in trust, effectiveness, and satisfaction within the same meeting episode (Bos et al., 2002; Bailenson, 2021).

Turn-Taking Rigidity and Audio/Video Latency

Research on turn-taking in virtual meetings largely treats latency and desynchronisation as coordination problems, examining how timing disruption alters conversational

flow and speaking rights. This work has been highly effective at characterising timing disruption. For instance, Seuren et al. (2021) conducted fine-grained conversational analysis to show how latency alters interruption timing and speaker overlap, while Heldner and Edlund (2010) quantified pause duration as a marker of turn-transition difficulty. However, these studies primarily treat overlap and pauses as coordination endpoints, rather than testing how different forms of interruption are interpreted socially in dyadic video meetings, or how they affect trust and satisfaction alongside effectiveness. Virtual conversations also introduce structural limitations in turn-taking coordination, which can significantly impact engagement. Unlike face-to-face interactions, where cues, speaker overlap, and gaze shifts facilitate smooth conversational transitions (Sacks et al., 1974), virtual settings impose artificial turn-taking constraints. These constraints arise from audio latency, desynchronisation of visual and auditory cues, and lack of shared attention indicators (Koudenburg et al., 2013). Research suggests that virtual meetings are marked by conversational obstacles, where participants either speak over each other or hesitate excessively, disrupting natural dialogue rhythm (Whittaker, 2003).

Studies show that even slight network delays (30–70 milliseconds) in audio-visual synchronisation disrupt conversational flow, increasing the likelihood of interruptions, unnatural pauses, and overlap errors (Boland et al., 2022). These disruptions not only affect turn-taking coordination but also contribute to cognitive strain, as participants must exert additional effort to decode misaligned verbal and non-verbal cues in real-time (Bailenson, 2021). Over long interactions, this increased mental load compounds, leading to Zoom fatigue - a state of cognitive exhaustion caused by the unnatural rhythm and heightened attentional demands of virtual meetings (Fauville et al., 2021). These findings suggest that latency is not merely a technical issue, but a core barrier to engagement and conversational fluidity in remote interactions. The rigidity imposed by latency has been found to be particularly problematic for speakers attempting to establish rapport or respond quickly in fast-paced conversational exchanges (Seuren et al., 2021). Extending this pattern, the literature tends to frame latency as a coordination problem, emphasising effectiveness, while treating trust and satisfaction as secondary or inferred outcomes rather than directly measured variables (Bailenson, 2021; Seuren et al., 2021). As a result, technical mitigation is frequently evaluated through task or flow metrics, but not through whether participants become more trusting, feel treated fairly, or report higher satisfaction, which prevents clear inference about whole-state improvement.

A comparative analysis of video conferencing platforms suggests that engagement difficulties vary across different systems. Studies indicate that users in Zoom meetings experience more frequent conversational overlaps and interruptions compared to Microsoft Teams, largely due to differences in audio buffering algorithms and noise cancellation settings (Mora-Jimenez et al., 2022). Microsoft Teams, for example, utilises

aggressive noise suppression, which, while effective at removing background distractions, can also clip the beginning or end of spoken utterances, making natural turn-taking more difficult (Karl et al., 2022). VR-based communication platforms such as Spatial and EngageVR (Rogers et al., 2022; Chae et al., 2025) offer alternative solutions by integrating spatial audio and avatar-based gaze alignment, which restore some level of naturalistic conversational flow. However, VR-mediated platforms present their own engagement challenges, such as motion sickness, avatar realism concerns, and technological accessibility constraints (Bailenson, 2021). These platform comparisons highlight that engagement breakdowns are not only interactional but infrastructural, yet few studies examine how such technical differences differentially affect the triangular state across trust, effectiveness, and satisfaction. Platform comparisons therefore suggest that technical design choices matter, but they rarely isolate whether observed improvements in conversational timing are due to reduced latency itself, altered turn-taking norms such as muting behaviour, or participant adaptation, which complicates translation into intervention design.

Cognitive Overload and Virtual Fatigue

In addition to structural turn-taking issues discussed earlier, virtual meetings place a disproportionate cognitive load on participants, resulting in higher mental fatigue (Shockley et al., 2021; Bailenson, 2021). This line of work predominantly evaluates well-being and satisfaction outcomes, with effectiveness effects either assumed or examined indirectly through participation decline. For instance, Fauville et al. (2021) used self-report fatigue scales across extended video meeting exposure to demonstrate increased self-consciousness and attentional strain, while Shockley et al. (2021) examined well-being decline over repeated virtual interactions. Consistent with earlier sections, these studies robustly document satisfaction and wellbeing costs, but they do not examine which moment-to-moment conversational behaviours - such as extended silences or reduced backchanneling - precede disengagement in dyadic meetings, limiting their usefulness for real-time intervention design.

Zoom fatigue has been linked to several underlying factors. First, excessive self-view exposure in video calls increases self-consciousness and social anxiety, making long interactions mentally exhausting (Fauville et al., 2021). Second, the heightened need for verbal compensation due to missing non-verbal cues forces participants to engage in constant linguistic elaboration, increasing cognitive strain (Bailenson, 2021). Third, the lack of spatial mobility in virtual meetings - where participants remain seated and largely motionless for extended periods - leads to physical discomfort and disengagement (Shockley et al., 2021). A study by Yang et al. (2021) found that participants in long-duration video meetings exhibited declining engagement, with increased passivity, reduced verbal contributions, and disengaged body language over time. These studies demonstrate disengagement trajectories, but do not establish which observable

interactional markers, such as longer inter-pauses or reduced backchannels, are the earliest reliable predictors, leaving a gap for metric-based feedback systems that require operational definitions. These findings suggest that extended exposure to video-based communication diminishes overall engagement and negatively affects conversational spontaneity. This line of work primarily evaluates satisfaction and wellbeing consequences, while offering less clarity on when fatigue directly impairs task effectiveness, which complicates decisions about whether interventions should prioritise comfort, performance, or their interaction within the triangular state (Fauville et al., 2021; Shockley et al., 2021).

Trust Deficits and Social Presence Challenges

Trust-focused studies in virtual communication primarily examine early interaction stages and unfamiliar teams, often treating trust either as a prerequisite for collaboration or as an emergent outcome of interaction quality. Classic trust work in virtual teams therefore explains the conditions under which trust struggles to form. For example, Jarvenpaa and Leidner (1999) examined trust development across distributed teams over time, showing that delayed feedback and reduced social cues slow trust formation, while Walther (1996) demonstrated that relational depth can emerge through extended interaction despite cue loss. Building on the limitation identified above, both approaches rely on longitudinal or repeated interaction designs, offering limited guidance for short, first-contact dyadic meetings where trust must be established or repaired within a single session. In addition to cognitive strain, virtual dyads face greater challenges in building trust and establishing rapport compared to co-located interactions (Breuer et al., 2016; Gutman et al., 2022). Unlike face-to-face meetings, where physical proximity fosters informal bonding and spontaneous small talk, video-based interactions introduce barriers to social warmth and relationship development (Standaert et al., 2021; Gutman et al., 2022). Studies on virtual teams suggest that trust development in remote settings is significantly slower, particularly when participants lack prior in-person familiarity (Jarvenpaa and Leidner, 1999). However, these findings are often derived from team or organisational contexts, where interaction is distributed over time and across multiple members, rather than from short, first-contact dyadic meetings where awkwardness and uncertainty must be resolved rapidly.

Trust formation in virtual settings is influenced by several factors, including reduced informal socialisation opportunities, increased reliance on task-oriented discourse, and a tendency toward conversational formality (Breuer et al., 2016; Degutyte and Astell, 2021). Research suggests that in the absence of casual bonding moments, virtual teams default to transactional, efficiency-driven styles, which limit the development of interpersonal warmth and mutual understanding (Yang et al., 2021). A comparative analysis of trust formation across different communication modalities highlights distinct advantages and limitations. In video conferencing, trust-building is moderate, as participants

benefit from real-time verbal and facial cues but still struggle with informal socialisation constraints (Standaert et al., 2021). In text-based asynchronous communication, trust development is slower but allows for deeper message reflection and reduced social inhibition, which can foster more thoughtful discourse over time (Herring, 2007; Walther, 1996). VR-mediated communication, in contrast, offers higher social presence due to spatial immersion and restored non-verbal cues, but remains limited by technological barriers and user adoption concerns (Rogers et al., 2022). Although trust is widely treated as foundational, studies vary in whether trust is framed as a prerequisite for effective collaboration or as an outcome that is itself shaped by interaction quality, highlighting the need for a lens that can accommodate both directions of influence within a single analytic framework (Jarvenpaa and Leidner, 1999; Walther, 1996). This ambiguity matters because if trust is treated only as a prerequisite, design effort tends to focus on pre-meeting scaffolding, whereas if trust is treated as an emergent outcome, design effort shifts towards in-meeting behavioural support, yet few studies test both positions within one coherent evaluation.

These challenges underscore the need for systems that support conversational dynamics in real-time - yet most platforms lack mechanisms for providing subtle, real-time feedback or guidance during interaction. In contrast to descriptive accounts of engagement breakdown, a smaller body of work explores design-led frameworks that treat awareness and reflection as intervention mechanisms. One direction that expands the conceptual scope of engagement support is the Experiment in a Box (XB) framework (schraefel et al., 2021), which reframes system design as a self-guided experimental process for cultivating knowledge, skills, and practice. While originally applied to personal health contexts, the XB approach highlights transferable design principles - such as guided reflection, user autonomy, and short-term experimental framing - that resonate with current efforts in HCI to create modular, non-intrusive systems for engagement, particularly in contexts that demand both structure and flexibility. This work establishes a foundational rationale for supporting personal experimentation, self-guidance, and reflexivity as central components of interactive system design. It strongly motivates the development of tools that enable individuals to experiment with and adapt their own interaction patterns - originally for health practices like sleep regulation, but here extended to the domain of conversational engagement in virtual meetings. This thesis builds upon that direction by grounding its interventions in reflection and self-experimentation, inspired in part by the ”in5” framing referenced in this work (schraefel et al., 2021) and introduced in earlier research by schraefel (2019), where engagement is positioned as a critical vector of wellbeing. This perspective is especially pertinent in the context of remote collaboration, where engagement quality is increasingly central to digital health and social sustainability. In the context of this thesis, such experimental framing is treated as a mechanism for deliberately shifting the triangular state, providing a conceptual foundation for interventions that make engagement visible without imposing external judgement.

Taken together, these challenge-focused literatures document recurrent engagement breakdowns in virtual communication, but rarely examine how interventions might stabilise trust, effectiveness, and satisfaction simultaneously across different phases of a dyadic meeting. This limitation motivates the need for phase-sensitive, lightweight mechanisms that explicitly account for trade-offs within the triangular state.

2.2.3 Elements of Engagement: Discrepancies Between Virtual and In-Person Interaction

Comparative studies between virtual and in-person interactions consistently highlight structural and psychological differences in engagement, conversational fluidity, and social presence (Bailenson, 2021; Standaert et al., 2021). While digital communication has become an integral part of remote collaboration, research suggests that virtual environments fundamentally alter interactional norms, introducing higher cognitive demands, reduced spontaneity, and weaker interpersonal bonds (Degutyte and Astell, 2021; Gutman et al., 2022). A recurring theme across disciplines is that virtual communication lacks the immediacy and multimodal richness of face-to-face exchanges, resulting in greater conversational rigidity and social distance (Short et al., 1976; Walther, 1996). Across this comparative literature, studies vary in whether discrepancies between virtual and in-person interaction are framed as unavoidable structural deficits, compensable through technological augmentation, or mitigable through behavioural adaptation. This subsection therefore examines how different explanatory accounts address engagement loss, and where they fail to provide actionable guidance for stabilising trust, effectiveness, and satisfaction in everyday video-based dyadic meetings.

One of the biggest disruptions in virtual interactions is the absence of physical co-presence, which significantly impacts social bonding and group cohesion (Breuer et al., 2016). Psychological theories of social interaction suggest that face-to-face encounters rely on embodied synchrony, where shared physical space, unconscious mimicry, and micro-adjustments in posture, gaze, and expression contribute to social rapport (Kleinke, 1986; Degutyte and Astell, 2021). In contrast, virtual meetings often create a cognitive disconnect, as participants lack shared sensory input and peripheral awareness, making interactions feel less immersive and more transactional (Walther, 1996; Gutman et al., 2022). While these accounts convincingly explain why virtual interaction feels less socially rich, they primarily diagnose loss rather than identify mechanisms through which engagement might be deliberately reconstructed under digital constraints.

Eye Contact and Non-Verbal Cues in Virtual Settings

Research on eye contact in video-based communication suggests that participants experience difficulty maintaining gaze alignment, leading to reduced perceptions of interpersonal connection and mutual attentiveness (Degutyte and Astell, 2021). In face-to-face settings, gaze regulation serves multiple functions: it signals interest, turn-taking readiness, and emotional involvement (Kleinke, 1986). However, video conferencing platforms disrupt gaze reciprocity due to camera-screen misalignment, where individuals look at their partner's image on-screen rather than directly into the camera (Rogers et al., 2022; Degutyte and Astell, 2021). This breaks natural synchrony, making conversations feel less engaging and more performative (Bailenson, 2021). Although this work clearly links gaze disruption to reduced social presence and trust, it offers limited insight into how such losses affect effectiveness and satisfaction simultaneously, or how systems might support engagement without attempting full cue restoration. Similarly, the absence of shared body language cues in virtual communication diminishes social presence, comfortableness and interaction fluidity. In co-located conversations, subtle movements - such as leaning in, shifting posture, or gesturing spontaneously - help regulate turn-taking and reinforce conversational engagement (Kleinke, 1986; Degutyte and Astell, 2021). In video-based settings, these cues are either cropped out by the camera, delayed by network latency, or consciously exaggerated to compensate, all of which affect how participants perceive engagement levels and social dynamics (Derks et al., 2008).

Turn-Taking and Interaction Flow

Turn-taking dynamics also differ significantly between virtual and face-to-face settings. Prior work diverges here between interactional accounts that treat interruption as socially meaningful behaviour and technical accounts that frame turn-taking disruption as a latency or platform constraint. In physical conversations, interruptions often occur organically and serve as rapport-building mechanisms, reflecting engagement and enthusiasm rather than conversational dominance (Heldner and Edlund, 2010). However, in virtual meetings, interruptions are perceived as more disruptive, primarily due to audio lag, desynchronsation, and the inability to rely on gaze and body positioning to negotiate speaking turns (Heldner and Edlund, 2010). This shift suggests that behaviours interpreted as affiliative in co-located settings are reinterpreted as dominance or incompetence in mediated contexts, with implications for both trust and satisfaction. Research suggests that virtual turn-taking is more unnatural, as participants must explicitly signal intent to speak, leading to longer pauses, abrupt transitions, and decreased conversational fluidity (Seuren et al., 2021). The structure of virtual turn-taking also varies across different communication platforms. For instance, platform-specific features, like Zoom's "mute/unmute" function enforces stricter turn-taking but also limits spontaneous verbal affirmations and backchannels ("mm-hmm", "yeah"), reducing conversational cohesion (Fauville et al., 2021). Microsoft Teams, by contrast, employs aggressive noise cancellation, which, while beneficial for filtering background

disturbances, can accidentally suppress backchannel responses, making conversations feel less natural (Mora-Jimenez et al., 2022). In contrast, VR-based platforms such as EngageVR restore some degree of natural interaction flow by incorporating spatial audio and avatar-based eye contact, facilitating more intuitive conversational exchanges (Rogers et al., 2022). While these platform-level comparisons demonstrate that design choices shape conversational flow, they stop short of evaluating whether restoring naturalistic turn-taking improves engagement outcomes, or merely shifts effort elsewhere in the interaction.

Can Virtual Communication Fully Replicate In-Person Engagement?

Beyond technical and structural challenges, the social-psychological effects of virtual engagement have also been widely debated. Research suggests that virtual teams experience lower group cohesion due to a lack of informal bonding moments, which are more common in face-to-face interactions (Breuer et al., 2016; Standaert et al., 2021). These findings are often interpreted as evidence of inherent inferiority in virtual communication, rather than as a prompt to explore alternative design strategies that operate within digital constraints. Longitudinal studies on remote collaboration further indicate that motivation and engagement levels decline over time, particularly in teams that rely exclusively on video-based communication without in-person interactions (Breuer et al., 2016). These findings suggest that maintaining high levels of social presence and trust over extended periods in virtual settings remains an unresolved challenge in digital collaboration research.

A longstanding debate in communication research revolves around whether digital environments can ever fully replicate in-person engagement. Research argues that virtual interactions will always remain inferior due to the fundamental absence of embodied presence, shared physical context, and sensory immersion (Niedenthal et al., 2005; Short et al., 1976). According to Media Naturalness Theory (Kock, 2004), human communication evolved under conditions of face-to-face interaction, making real-world dialogue superior in terms of cognitive efficiency, social bonding, and engagement sustainability. This argument compellingly accounts for why video calls feel effortful, but it is limited as a design guide because it implies deficit rather than specifying which interactional components can be reconstructed without full embodiment. While influential, this perspective provides limited guidance for improving interaction quality in contexts where face-to-face communication is unavailable or impractical, a limitation that constrains its applicability to contemporary remote work. Conversely, recent research suggests that advancements in VR, Artificial Intelligence, and multimodal communication technologies may help narrow the gap between virtual and physical interaction quality (Rogers et al., 2022; Chae et al., 2025). For instance, VR environments are argued to restore elements such as spatial dynamics, proxemics, and shared environmental context, potentially making remote interactions more socially immersive and

less cognitively taxing than traditional video conferencing (Rogers et al., 2022). Similarly, AI-driven affective computing systems can detect and adapt to user emotions in real-time, enhancing social presence and engagement in virtual meetings (McGrath and Nnamoko, 2023). However, this literature often demonstrates detection capability, but does not show that algorithmic inference improves conversational balance or satisfaction without introducing evaluation anxiety, which is central to designing gentle feedback. Furthermore, these approaches prioritise cue replication through technological escalation, raising concerns around accessibility, scalability, and cognitive overhead for everyday dyadic meetings. Such technologies remain financially and logistically inaccessible for most everyday contexts, making simple, scalable solutions for standard video calls all the more vital.

Implications for Future Research

Taken together, the comparative literature demonstrates persistent discrepancies between virtual and in-person interaction, but offers fragmented guidance on how engagement can be systematically supported without either accepting reduced interaction quality or relying on high-cost technological replication. While synchronous and asynchronous strategies each offer unique advantages, researchers continue to explore hybrid approaches that blend structured interventions, conversational cue awareness, and adaptive feedback systems to optimise remote communication dynamics (Standaert et al., 2021; Yang et al., 2021). These discrepancies suggest that engagement interventions must be evaluated in terms of (1) which element of the triangular state they primarily stabilise; (2) which elements they may unintentionally trade off, particularly under conditions of unfamiliarity, cue loss, or sustained task demand, and (3) whether gains in one element introduce compensatory costs in the others. The following sections examine these approaches, analysing how out-of-meeting (asynchronous) and in-meeting (synchronous) interventions can mitigate engagement deficits and improve interaction outcomes.

This unresolved tension between diagnosis, replication, and reconstruction motivates the need for lightweight, phase-sensitive interventions that explicitly target different elements of the triangular state across the meeting lifecycle.

2.3 Governing Lens: The Triangular State of Team Dynamics in Virtual Dyadic Communication

Across the literature on CMC, virtual collaboration, and meeting science, three outcomes repeatedly emerge as central to whether a virtual interaction is experienced as successful: trust between participants, the effectiveness of task coordination, and satisfaction with the interactional process (Jarvenpaa and Leidner, 1999; Walther, 1996;

Standaert et al., 2021). These outcomes have been extensively examined in prior work, yet typically in isolation or within narrow contextual frames. Trust is often studied in relation to familiarity, social presence, or early interaction stages (Bos et al., 2002; Breuer et al., 2016). Effectiveness is commonly operationalised through task performance or decision efficiency (Dennis et al., 2008; Fayard and DeSanctis, 2010), and satisfaction is frequently treated as a post-hoc evaluative measure of meeting quality or user experience (Bailenson, 2021; Fauville et al., 2021). What remains underdeveloped is an integrated account of how these outcomes interact as a coupled state within video-based dyadic meetings. Across the literature, these outcomes are operationalised using distinct constructs, metrics, and temporal scopes, which limits the ability to reason about trade-offs or co-occurring effects within a single meeting episode.

Existing studies implicitly acknowledge the interdependence of these outcomes but rarely formalise it. The preceding sections demonstrate through distinct analytical lenses that many of the most cited engagement challenges - cue loss, latency, fatigue, and reduced social presence - map onto different corners of this state, yet are rarely discussed as simultaneously active constraints within the same dyadic meeting. For example, research on virtual trust formation demonstrates that reduced social cues and delayed feedback can inhibit early trust, which in turn constrains information sharing and collaboration effectiveness (Jarvenpaa and Leidner, 1999; Walther et al., 2005). Conversely, studies focused on conversational imbalance and turn-taking breakdowns show that dominance and disruption can impair perceived fairness and satisfaction, even when task outcomes are achieved (Bailenson, 2021; Seuren et al., 2021). These findings suggest that improvements in effectiveness do not necessarily entail improvements in satisfaction or trust, and that gains in social comfort may not translate into task efficiency, particularly in short or cognitively-demanding meetings. Importantly, these relationships are rarely examined within the same empirical design, leaving uncertainty about how interventions that optimise one outcome reshape the overall interactional state.

Consistent with earlier sections, this fragmentation is especially consequential in dyadic interactions. Unlike group meetings, where facilitation, turn redistribution, or social buffering can mitigate imbalance, dyads place full responsibility for conversational regulation on two individuals (Kraut et al., 1988). As a result, small disruptions in turn-taking, pacing, or responsiveness can rapidly escalate into perceptions of dominance, awkwardness, or disengagement, with direct consequences for trust, perceived competence, and willingness to collaborate again (Bos et al., 2002; Gutman et al., 2022). Yet much of the existing literature treats these consequences as parallel outcomes rather than as components of a single interactional state. As a result, prior work provides limited guidance for designing interventions that must operate under simultaneous social, cognitive, and coordination constraints, particularly in dyadic settings where compensatory mechanisms are absent.

To address this gap, this thesis formalises and adopts the triangular state of team dynamics as a governing lens for analysing and designing engagement support in video-based dyadic communication. Within this lens, trust, team effectiveness, and team satisfaction are treated as interdependent and mutually constraining rather than as independent success metrics. Changes to one element may stabilise or destabilise the others depending on meeting context, participant familiarity, and the timing and intrusiveness of intervention. This lens therefore enables systematic reasoning about trade-offs, rather than assuming monotonic improvement across engagement outcomes. This framing allows engagement to be interpreted not as a unitary construct, but as a multi-outcome condition that emerges from the interaction between conversational behaviour, social cue availability, and meeting structure.

Importantly, the triangular state also supports a lifecycle view of dyadic video meetings. Prior work indicates that trust deficits and social awkwardness are most pronounced at meeting onset, particularly among unfamiliar dyads (Walther, 1996; Breuer et al., 2016), whereas conversational imbalance and cognitive load become more important during sustained real-time interaction (Bailenson, 2021; Fauville et al., 2021). This distinction motivates the separation between out-of-meeting and in-meeting opportunities for engagement support. Crucially, this separation is derived from patterns observed in the literature rather than from the interventions themselves, ensuring that the empirical studies test the lens rather than define it. The following sections therefore review asynchronous contexts, focusing on delayed interaction and structured pre-meeting mechanisms, before turning to synchronous contexts and real-time conversational dynamics. Together, these strands provide the theoretical foundation for the empirical studies that test, refine, and resolve the governing triangular state in Chapters 3, 4, and Chapter 5.

2.4 Foregrounded Psychological Theories Supporting Intervention Design

As mentioned in Chapter 1, the following psychological theories are foregrounded in this thesis because they directly explain the mechanisms through which structured interventions can support trust, team effectiveness, and team satisfaction in dyadic video meetings. Unlike broader theories of CMC, these perspectives explicitly address the cognitive, interpersonal, and regulatory constraints that the proposed interventions are designed to alter. They are therefore used to justify intervention design rather than to merely describe mediated interaction.

- **Common Ground Theory and Psychological Safety:** Common Ground Theory (Clark and Brennan, 1991) explains how mutual knowledge, assumptions, and

expectations are established and maintained during interaction. In dyadic communication, common ground supports trust by reducing uncertainty about intentions, competence, and social norms. While common ground is often built implicitly through repeated interaction, unfamiliar dyads lack shared context at meeting onset, particularly in video-based settings where informal cues are limited. This theory therefore motivates structured pre-meeting information exchange as a means of accelerating grounding processes before a first synchronous encounter. From a triangular state perspective, common ground primarily supports early trust formation, with downstream effects on conversational ease and perceived effectiveness. However, Common Ground Theory alone does not specify how such grounding should be operationalised in short-horizon, one-off professional encounters, which motivates empirical investigation of lightweight pre-meeting scaffolding mechanisms. Psychological safety (Edmondson, 1999) describes the extent to which individuals feel comfortable taking interpersonal risks without fear of embarrassment, judgement, or negative evaluation. In dyadic video meetings, poorly designed feedback risk undermining psychological safety by making participants feel evaluated or exposed. This is particularly salient in one-on-one settings, where feedback cannot be diffused across multiple participants. Psychological safety therefore operates as a cross-cutting constraint on intervention design, explaining why feedback mechanisms must remain subtle, shared, and non-evaluative. From the triangular state perspective, psychological safety is tightly coupled to trust and satisfaction, and constrains how cognitive and behavioural support mechanisms can be introduced without producing counterproductive effects;

- **Cognitive Load Theory and Behavioural Self-Regulation:** Cognitive Load Theory (Sweller, 2020) explains how limited attentional resources constrain performance when individuals must process multiple streams of information simultaneously. In synchronous video meetings, participants must monitor task content, conversational timing, social cues, and self-presentation under conditions of latency and cue degradation. This increases extraneous cognitive load and reduces capacity for behavioural self-regulation. Self-regulation perspectives further explain how individuals adjust their behaviour when feedback about performance is available, but struggle to do so when relevant cues are invisible or ambiguous (van Bruggen et al., 2002). These theories motivate in-meeting feedback mechanisms that externalise conversational dynamics, such as speaking balance or interruptions, in order to support behavioural adjustment without requiring continuous self-monitoring. From the triangular state perspective, cognitive load and self-regulation primarily influence effectiveness and satisfaction, but can also indirectly affect trust when imbalance or disruption persists. In this thesis, self-regulation is treated as the primary causal mechanism through which real-time feedback influences behaviour, whereas theories of mediated cue interpretation

are used only to characterise the interactional context in which regulation becomes necessary. Crucially, Cognitive Load Theory is used not only to justify the introduction of real-time engagement feedback, but also to constrain its design, acknowledging that poorly designed or overly salient feedback interfaces risk increasing extraneous cognitive load and undermining the very self-regulatory processes they are intended to support;

Together, these foregrounded psychological theories establish the mechanism-level rationale for the interventions examined in this thesis. They explain why structured pre-meeting and in-meeting supports should influence trust, team effectiveness, and team satisfaction in dyadic video meetings. The subsequent sections of this chapter furthermore discuss contextual theories of CMC, which are used to characterise the environments in which these mechanisms operate. Specifically, theories of asynchronous communication are reviewed to explain delayed interaction and pre-meeting contexts, while theories of synchronous interaction are reviewed to explain real-time conversational breakdowns. These contextual accounts situate the empirical studies by describing the communicative conditions under which interaction unfolds, but they do not redefine the governing stance of this thesis - the triangular state of team dynamics - nor replace the foregrounded psychological theories mentioned above that justify how and why the proposed interventions operate. In other words, the triangular state defines the evaluative outcomes, the foregrounded psychological theories justify why the interventions should shift those outcomes, and the contextual theories describe the mediated environments in which those mechanisms operate.

2.5 Asynchronous Contexts: Out-of-Meeting Communication and Delayed Interaction

2.5.1 The Role of Asynchronous Communication in Virtual Collaboration

Asynchronous communication plays a crucial role in digital collaboration by allowing participants to engage in discussions without the constraints of real-time interaction (Nagel et al., 2024; Walther, 1996). Unlike synchronous exchanges, where information is processed and responded to instantaneously, asynchronous interactions afford individuals greater cognitive reflection, message composition time, and flexibility in participation (Fabriz et al., 2021; Dennis et al., 2008). These features make asynchronous communication particularly effective in contexts where individuals must deliberate over complex topics, provide detailed responses, or accommodate differing time zones (Berry, 2006). Within the triangular state, asynchronous formats tend to support trust and satisfaction through reduced time pressure and increased self-presentation control, while their limitations most directly threaten effectiveness through delayed convergence and

reduced conversational continuity (Dennis et al., 2008; Walther, 1996). However, most of this evidence is derived from group-based, text-centric, or longitudinal collaboration contexts, rather than from short-horizon dyadic encounters preceding live video interaction. As a result, studies demonstrate that asynchronous interaction supports reflection and equity. For example, Neblo et al. (2018) showed that asynchronous discussion reduces participation inequality by lowering interruption pressure, while Nowland et al. (2018) demonstrated increased contribution from less confident participants in text-based exchanges. However, this body of work leaves a clear gap: these studies focus on contribution volume rather than interpersonal ease, and do not test whether such benefits translate into smoother turn-taking or reduced awkwardness at the onset of a live dyadic video call. As a result, it remains unclear whether these benefits translate into interpersonal readiness for first-time dyadic video interaction.

A key benefit of asynchronous communication is its ability to facilitate more equal participation in group interactions. Research suggests that in real-time conversations, dominant individuals tend to monopolise discussions, often interrupting or speaking over others (Neblo et al., 2018; Heldner and Edlund, 2010). In contrast, asynchronous settings allow more reserved individuals to contribute without pressure, leading to a more balanced exchange of ideas (Nowland et al., 2018; Neblo et al., 2018). This aligns with Social Compensation Theory, which highlights that individuals who feel less confident in verbal interactions may compensate through text-based contributions, thus reducing communication hierarchies (Nowland et al., 2018). While this work convincingly demonstrates participation equalisation in asynchronous settings, it largely focuses on contribution volume rather than on interpersonal orientation, first impressions, or relational ease at interaction onset. Moreover, equal participation in text does not necessarily imply equal conversational agency in live video, where turn-taking rights are negotiated under latency and cue loss, suggesting a gap between contribution opportunity and real-time conversational regulation. At the same time, despite its advantages, asynchronous communication also presents several limitations. The lack of immediate feedback can lead to misinterpretations, prolonged decision-making, and difficulties in sustaining engagement (Nagel et al., 2024). Studies have shown that delays in response time can diminish conversational coherence, making interactions feel impersonal (Nagel et al., 2024). Additionally, the absence of vocal and non-verbal cues in asynchronous communication can obscure speaker intentions and conversational alignment (Walther, 2015). As a result, existing asynchronous mechanisms provide limited support for establishing social presence or reducing awkwardness prior to first-time synchronous encounters. This reveals a gap between mechanisms that equalise contribution opportunities in text and mechanisms that support conversational agency and comfort once dyads transition into live, turn-regulated interaction.

Given these strengths and limitations, asynchronous communication is more suitable for certain professional fields than others. This distinction highlights that asynchronous

communication is rarely treated as a preparatory stage for synchronous interaction, but rather as a standalone mode optimised for either reflection or coordination. Research indicates that education, scientific collaboration, and knowledge-intensive work benefit from asynchronous formats, as they allow for deep cognitive processing, discussions, and sustained reflection (Fabriz et al., 2021). Conversely, in fields such as medicine, emergency response, and high-stakes decision-making, where rapid information exchange is critical, asynchronous methods can introduce dangerous inefficiencies (Culmer et al., 2023). Studies on healthcare communication highlight that while asynchronous messaging platforms (i.e. electronic health records, emails) aid coordination, critical patient-care decisions still require real-time discussion to avoid medical errors (Culmer et al., 2023). These findings reinforce that asynchronous communication alone cannot resolve coordination demands, but they do not examine whether structured asynchronous preparation could improve subsequent real-time interaction quality. This line of work therefore clarifies where asynchronous tools fail for time-critical coordination, but it does not examine whether a short, structured pre-meeting mechanism could still improve subsequent interaction quality by reducing uncertainty and increasing common ground. Moreover, cultural factors play a significant role in shaping preferences for asynchronous vs. synchronous communication. According to Hall (1976) and the Theory of High-Context vs. Low-Context Cultures, Western communication styles (i.e. the US, UK, Germany) favour direct, fast-paced exchanges, making synchronous interaction preferable for many professional and social settings. In contrast, Eastern cultures (i.e. Japan, China, Korea) tend to be more comfortable with delayed responses and deeper reflection, aligning more with asynchronous communication norms (Chang et al., 2024). Cross-cultural studies show that Western professionals often perceive delays in response as disengagement, while Eastern professionals view them as thoughtful deliberation (Chang et al., 2024). This difference suggests that effective virtual collaboration across cultural contexts requires adaptive strategies that balance asynchronous and synchronous elements (Martin et al., 2020). Notably, this body of work focuses on message timing norms rather than on how pre-meeting familiarity or interpersonal grounding might moderate cultural misinterpretation in live video settings. These findings clarify where asynchronous communication fails as a substitute for real-time coordination, but do not examine whether short, structured pre-meeting interaction could still reduce uncertainty and improve interpersonal grounding before synchronous dyadic exchange.

Taken together, the asynchronous communication literature demonstrates strong support for reflection, equity, and reduced time pressure, but offers limited guidance on how asynchronous mechanisms can be deliberately structured to support trust formation and interactional ease immediately before dyadic video meetings.

2.5.2 Theoretical Perspectives on Delayed Interaction and Engagement

The following theory was selected because it is one of the most commonly-used frameworks for explaining engagement, coordination, and social meaning in asynchronous computer-mediated communication. These theoretical perspectives have been applied to understand how asynchronous communication shapes engagement and interaction quality:

- **Media Synchronicity Theory (MST):** Dennis et al. (2008) highlights that different communication modes afford varying levels of process convergence - the ability of participants to reach a shared understanding efficiently. While MST suggests that asynchronous communication can support complex information processing tasks, especially when participants require time to reflect or coordinate across time zones, it does not account for hybrid settings, where individuals frequently switch between asynchronous preparation and synchronous discussion (Dennis et al., 2008). However, MST primarily evaluates communication effectiveness in terms of convergence efficiency, offering limited insight into interpersonal outcomes such as trust formation or interactional comfort. This limitation exposes a gap about how best to structure asynchronous out-of-meeting interactions to optimise engagement in real-time collaboration - a key gap in current research (Martin et al., 2020). MST therefore clarifies why asynchronous tools can support convergence, but it does not specify what design features create interpersonal readiness, such as perceived warmth or reduced awkwardness, which are necessary for dyadic trust at meeting onset.

Overall, MST characterises delayed interaction in terms of channel properties and convergence processes, but it does not directly address how short, structured pre-meeting exchanges can be designed to accelerate trust and conversational readiness immediately before a dyadic video meeting. This gap motivates the empirical focus on ASGPIs as a lightweight out-of-meeting mechanism.

While asynchronous communication is consistently shown to offer advantages in flexibility, cognitive reflection, and cross-cultural adaptability, its lack of immediate responsiveness and conversational continuity presents persistent engagement challenges. The difficulty in maintaining cohesion, trust formation, and shared contextual understanding remains a major limitation in fully replicating the engagement levels of synchronous communication (Dennis et al., 2008; Walther, 2015). Furthermore, while structured asynchronous interactions have been explored in educational and collaborative work settings, research has yet to establish the most effective mechanisms for bridging asynchronous preparation with real-time conversational engagement (Martin et al., 2020). The need for structured approaches to enhance continuity between asynchronous and synchronous interactions remains a critical challenge in video-based communication

research - an issue that requires further empirical exploration. While asynchronous communication has been widely studied in educational and team-based contexts, research has yet to address its potential for establishing rapport and reducing awkwardness in first-time virtual dyadic meetings. However, these theories are typically applied to group or organisational settings, and provide limited guidance on how structured pre-meeting mechanisms might shift trust and satisfaction in unfamiliar dyads before the first synchronous encounter. This gap highlights the importance of designing pre-meeting structures that can foster initial familiarity and ease, particularly in remote dyads formed without prior interpersonal contact - a need that this thesis directly addresses.

2.5.3 Mapping ASGPIs

While multiple theories account for delayed interaction and reflection in asynchronous communication, the ASGPI intervention is justified specifically through Common Ground Theory under unfamiliarity, rather than through convergence efficiency or long-term relational adaptation.

Across the empirical findings and theoretical limitations identified above, a consistent gap emerges: while MST explains how delayed interaction can support reflection and channel-appropriate information exchange, it does not specify how asynchronous mechanisms can be structured to prepare unfamiliar dyads for an imminent first video meeting. Empirical studies demonstrate benefits for contribution equity, reflection, and reduced inhibition, but do not examine whether these benefits translate into increased interpersonal ease, trust, or conversational readiness at the onset of synchronous interaction. This gap directly motivates the use of asynchronous self-generated pre-recorded introductions (ASGPIs) as a structured pre-meeting mechanism. ASGPIs are designed to operate within the strengths identified in the literature, namely reflection time and controlled self-presentation, while targeting an outcome that prior work does not address directly: reducing awkwardness and accelerating trust formation immediately before first-time dyadic video interaction. Methodologically, this gap motivates an experimental focus on unfamiliar dyads and early interaction outcomes, where trust, ease, and readiness must be established before any shared interaction history exists, rather than on long-term collaboration or contribution volume.

2.6 Synchronous Contexts: In-Meeting Conversational Dynamics

2.6.1 The Role of Real-Time Communication in Virtual Collaborations

In contrast to asynchronous tools that prepare participants before interaction, synchronous engagement support requires real-time responsiveness - yet this remains one of the most underdeveloped areas in dyadic video communication, particularly with respect to in-the-moment support for conversational self-regulation. Unlike asynchronous communication, synchronous interactions require individuals to process multiple conversational cues simultaneously, leading to challenges related to turn-taking, engagement balance, and speaker coordination (Garcia and Baker Jacobs, 1999; Heldner and Edlund, 2010). Studies have shown that virtual dyadic meetings often suffer from conversational dominance, where certain individuals monopolise speaking time, while others struggle to interject (Fayard and DeSanctis, 2010). For instance, Fayard and DeSanctis (2010) analysed how participation becomes uneven in organisational settings, showing that conversational dominance can persist even when teams remain task focused. However, this work primarily characterises imbalance as an outcome of meeting practice and structure, rather than testing an in-meeting mechanism that participants can use to self-correct as imbalance emerges. By contrast, micro analytic work on turn transitions, such as Garcia and Baker Jacobs (1999) and pause-based accounts such as Heldner and Edlund (2010), provides fine-grained evidence that timing cues, including gaze shifts and silence placement, regulate speaking rights, but these studies do not translate those behavioural markers into a lightweight feedback intervention for video based dyads. Taken together, this literature explains why dominance emerges and how turn-taking is signalled, but it leaves a gap around how systems can make imbalance visible in the moment without increasing cognitive load or social pressure. Thus, while this body of work explains why conversational dominance emerges and how turn-taking is signalled, it does not specify how systems might translate these signals into actionable, low-effort feedback that supports self-regulation during live dyadic interaction.

Building on the limitation identified above, dominance and imbalance are consistently identified as outcomes, yet the mechanisms for supporting participants during the interaction itself are rarely specified. In other words, this work identifies the outcome, dominance and imbalance, but rarely provides an intervention pathway that participants can enact during the conversation without diverting attention away from the task. One key reason for these imbalances is the absence of real-world turn-taking mechanisms such as gaze direction, body orientation, and non-verbal backchannels (Bailenson, 2021). In face-to-face interactions, subtle eye contact shifts and gesture cues signal turn transitions, allowing for natural engagement (Kendon, 1990). However, in

video-based conversations, these cues are often misaligned, delayed, or entirely absent, leading to increased interruptions and speaking over one another (Seuren et al., 2021; Wiederhold, 2020). While this body of work robustly documents cue degradation, it primarily treats breakdown as an unavoidable constraint rather than a design space for intervention. Earlier work documents that people adapt their behaviour under degraded channels, but it remains unclear which adaptations are beneficial versus harmful for the triangular state, for example whether speaking more slowly improves understanding at the expense of perceived competence or conversational naturalness. Additionally, research in conversational dynamics suggests that individuals adjust their speech patterns based on perceived dominance and engagement cues (Tanaka, 2000; Garcia and Baker Jacobs, 1999). Although these adaptations demonstrate conversational resilience, they also increase cognitive effort and remain invisible to the interaction partner, limiting their effectiveness as coordination mechanisms. For example, in real-time conversations, speakers often use features such as pitch variation, speech rate, and pauses to coordinate turn-taking and engagement management (Heldner and Edlund, 2010). However, studies indicate that these cues are often misinterpreted in virtual meetings due to microphone sensitivity, and lack of real-time synchronisation, resulting in disruptions (Bailenson, 2021; Schwartz et al., 2022). In triangular state terms, synchronous interaction is where effectiveness is most directly enacted, yet it is also where cue disruption can most rapidly undermine trust and satisfaction through interruptions, awkward pacing, and perceived dominance (Bailenson, 2021; Seuren et al., 2021). Much of the existing literature privileges effectiveness and coordination accuracy, while treating trust erosion and reduced satisfaction as secondary or emergent consequences rather than primary design concerns. This leaves a gap between documented behavioural adaptation and system-level support, where participants compensate individually for cue-loss but lack shared awareness of imbalance, limiting opportunities for mutual regulation without increased cognitive effort.

A similar constraint appears in timing research, where gesture timing is another critical factor in synchronous engagement. In face-to-face communication, hand gestures, head nods, and facial expressions are precisely timed to reinforce verbal content and regulate engagement (McNeill, 1992). However, in video-based settings, slight delays in gesture timing - even in the range of 100-300 milliseconds - can cause perceived disengagement or conversational awkwardness (Croes et al., 2016; Bailenson, 2021). For example, Croes et al. (2016) demonstrates that small disruptions to gesture-speech alignment alter how interpersonal intent and engagement are interpreted, while Kiesler et al. (1984) shows that lag changes perceived responsiveness and conversational quality under mediated conditions. These studies quantify sensitivity to delay and its perceptual consequences, but they do not examine whether presenting timing disruption to participants as real-time feedback improves coordination, or whether it intensifies self-monitoring and stress. In other words, the literature establishes that timing matters and that people notice misalignment, but it does not test the key design trade-off for

engagement feedback systems, whether awareness support stabilises turn-taking and perceived fairness, or instead undermines trust and satisfaction by making participants feel evaluated. Studies on video lag in virtual conversations reveal that when gestures and speech are not aligned, participants experience higher cognitive load and lower perceived conversational quality (Kiesler et al., 1984). This suggests that cue misalignment not only disrupts coordination but also creates a feedback gap, where participants lack awareness of how their behaviour is being perceived in real time. Given these findings, enhancing conversational awareness through in-meeting interventions could help mitigate engagement imbalances in virtual meetings. This gap motivates the need to explore how conversational cue manipulation - such as guiding participants to balance speaking time or encouraging adaptive turn-taking strategies - affects synchronous interaction quality. These timing studies quantify sensitivity to delay, but they do not test whether making timing disruption visible to participants improves coordination or instead heightens self-monitoring and stress, which is a central risk for real-time feedback. As a result, the literature establishes sensitivity to timing disruption but leaves unresolved whether making such disruption visible in real time stabilises conversational coordination or instead exacerbates self-monitoring, stress, and perceived evaluation.

2.6.2 Theoretical Perspectives on Real-Time Interaction and Cue Adaptation

Theoretical perspectives on synchronous CMC have primarily focused on how participants interpret and adapt to degraded conversational cues in real-time. While these accounts explain why cue misalignment affects engagement and social judgement, they offer limited guidance on how systems might support awareness or behavioural regulation during interaction without increasing cognitive load or social pressure. This subsection therefore reviews relevant contextual theory alongside empirical findings to identify where design gaps persist for real-time engagement support in dyadic video meetings.

The following theory is reviewed as a contextual account because it explains how people attempt to construct social meaning under constrained or degraded cue conditions. It is used here to characterise why cue misalignment in synchronous video interaction produces uneven interpretations of engagement, rather than to justify the feedback mechanism itself.

- **Social Information Processing Theory (SIPT):** Walther (1996) proposes that users adapt to the constraints of CMC by relying on available cues and developing compensatory signalling practices. Although SIPT was originally developed to explain interaction in cue-constrained CMC more broadly, it is used here as a

contextual account of how dyads adapt to misaligned cues in live video interaction. Its core claim remains relevant to synchronous video meetings, namely that participants infer engagement and relational intent using whatever signals remain reliable under mediation. In dyadic video interaction, this implies that when gaze, backchannels, and timing cues are degraded or misaligned, individuals still attempt to form judgements about attentiveness, dominance, or responsiveness, but these judgements may be unstable and unevenly distributed across the dyad. Importantly, SIPT assumes that relational meaning typically emerges over time through ongoing adaptation, which limits its explanatory power for short-horizon meetings where coordination must be achieved within a single session. SIPT therefore situates why cue misalignment becomes socially consequential in live video interaction, but it does not specify how minimal, non-evaluative feedback can support self-regulation without increasing cognitive load or undermining psychological safety. Accordingly, SIPT is not used in this thesis to explain behaviour change or feedback effectiveness, but solely to contextualise why unregulated cue interpretation in synchronous video interaction produces uneven social judgements that feedback systems may help stabilise.

SIPT explains why cue misalignment in synchronous video interaction becomes socially consequential, but it does not specify how systems might support dyads in recognising or regulating these effects during interaction. The following literature therefore examines specific conversational cue classes where this limitation becomes most visible. A vast body of research has examined how conversational cues shape engagement in real-time interactions, typically focusing on isolated cue classes rather than integrated conversational regulation:

- **Backchanneling and turn-taking signals** - Studies on backchanneling indicate that these cues play a crucial role in maintaining conversational cohesion and signalling attentiveness (Clark and Brennan, 1991; Bohus and Horvitz, 2011). However, in virtual meetings, backchanneling is often reduced, leading to decreased conversational fluidity (Fayard and DeSanctis, 2010). Furthermore, research suggests that the absence of real-time backchannel feedback can make speakers feel unheard or disengaged, contributing to higher levels of conversational asymmetry (Wiederhold, 2020). These studies establish the importance of feedback signals for conversational flow, yet primarily describe their absence rather than proposing mechanisms to restore them in real time. For instance, Bohus and Horvitz (2011) models backchannel timing as interactional evidence, but does not evaluate whether surfacing backchannel absence as feedback changes behaviour without disrupting conversational flow;

- **Prosody, speech rhythm, and paralanguage** - Elements such as intonation, stress, and rhythm significantly affect engagement and turn-taking regulation in real-time conversations (Rogerson-Revell, 2007). Synchronous conversations require fluid prosody to signal speaker transitions, but audio delays and compression artefacts in video calls often disrupt these natural speech cues, leading to awkward conversational timing (Bailenson, 2021; Schwartz et al., 2022). Research in computer-mediated prosody adaptation shows that participants tend to exaggerate intonation and elongate pauses in virtual settings to compensate for delayed turn recognition (Seuren et al., 2021). While this work explains how speakers adapt acoustically to degraded channels, it places the burden of coordination on individuals rather than on system-level support. Similarly, Rogerson-Revell (2007) characterises prosodic signalling in interaction, but does not test system support that could externalise these cues for dyadic video calls;

- **Gesture and facial expression timing** - Hand gestures, facial expressions, and body movements contribute to meaning-making and conversational engagement (McNeill, 1992). In synchronous video-based communication, however, latency in gesture timing often causes disruptions in perceived engagement, leading to a lower sense of interpersonal connection (Croes et al., 2016). Misaligned gesture-speech synchrony makes virtual interactions less intuitive, increasing the likelihood of perceived disengagement or inattentiveness (Oh et al., 2018). Gesture research highlights timing sensitivity, but offers limited guidance on how participants might regain awareness of misalignment as it occurs;

- **Gaze alignment and social presence** - Research on eye contact and gaze alignment in video-based communication suggests that trust-building and engagement suffer when participants struggle to establish mutual gaze (Basile et al., 2022). Unlike in-person conversations, where eye contact fosters interpersonal closeness and conversational regulation, virtual meetings often result in misaligned gaze perception, causing participants to feel less socially connected (Bohus and Horvitz, 2011). Experimental studies indicate that even a 5-degree misalignment in virtual eye contact can reduce trust and perceived attentiveness (Kiesler et al., 1984). Although gaze misalignment is well quantified, it is typically treated as a perceptual limitation rather than a target for behavioural or design intervention.

Across cue classes, the gap is not a lack of understanding of conversational signals, but a lack of evidence on how minimal, interpretable feedback can externalise these signals for dyads in real-time without disrupting interactional flow or social comfort. The literature is strong at describing what is lost, but weaker at demonstrating what minimal, non-disruptive feedback can restore conversational regulation in dyads without inducing stress or shifting attention away from the partner.

Despite advances in video conferencing technologies, virtual dyadic meetings still face problems with misaligned conversational cues - including gesture, gaze, and speech timing - which remain major barriers to achieving smooth, balanced, and low-effort interaction (Vertegaal, 1999; McNeill, 1992; Kendon, 1990). While some real-time systems have been developed to improve communication, these are rarely adapted to the specific challenges of dyadic interaction, where only two people must manage the entire flow of conversation, and where mutual regulation cannot be distributed across multiple participants or external facilitation. In many cases, existing tools increase mental effort by demanding too much attention or manual adjustment during the meeting (Rogerson-Revell, 2007; Seuren et al., 2021), effectively trading coordination support for increased cognitive load and reduced conversational naturalness. Although cue misalignment is well documented across cue classes, there are still very few systems that support real-time restoration of engagement balance in one-on-one video meetings - highlighting the need for gentle, in-the-moment feedback that supports communication without interrupting it.

2.6.3 Mapping Feedback on Engagement Metrics

While contextual theories of synchronous CMC explain how participants interpret and adapt to degraded conversational cues, the engagement-metrics intervention is justified through Cognitive Load Theory and self-regulation, which explain why in-meeting cue loss increases monitoring demands and undermines behavioural control.

Across the synchronous literature reviewed above, a consistent gap emerges: while conversational imbalance, cue misalignment, and dominance are well documented, there is limited evidence on how dyads can be supported to recognise and regulate these breakdowns during interaction without increasing cognitive load or social pressure. Prior work explains how turn-taking signals operate and how participants adapt under degraded conditions, but rarely evaluates whether system-mediated feedback can make imbalance visible in a way that preserves trust and interactional ease.

Engagement metrics address this gap by externalising conversational dynamics that are otherwise inferred implicitly, such as speaking balance, interruptions, and pauses, and making them perceptible in real time. Rather than attempting to restore missing cues directly, engagement metrics operate at a meta-conversational level, supporting awareness of interaction patterns without prescribing specific behavioural responses. This approach aligns with findings that individual adaptation alone increases cognitive effort, and instead seeks to support mutual regulation through shared awareness.

Importantly, the synchronous literature also highlights a central design risk: real-time feedback may heighten self-monitoring and stress if perceived as evaluative or intrusive. This motivates the need to empirically test not only whether engagement metrics

influence conversational behaviour, but whether they do so without undermining trust or satisfaction. Methodologically, this gap justifies examining engagement metrics in familiar dyads and focusing on trade-offs across the triangular state, rather than optimising coordination accuracy alone. Chapter 4 operationalises this approach by systematically varying feedback presence and examining its behavioural and perceptual effects during live dyadic interaction.

Taken together, the literature reviewed in this chapter shows that engagement challenges in video-based dyadic meetings are not confined to a single moment of interaction, but unfold across the meeting lifecycle. Collectively, this body of work demonstrates systematic coverage of engagement breakdowns, but limited systematic evaluation of how and when structured interventions should be introduced to support multiple interaction outcomes simultaneously. Prior research has examined asynchronous preparation and synchronous conversational cues largely in isolation, leaving limited guidance on how interventions should be structured to support the triangular state of team dynamics across different phases of dyadic collaboration. Where prior work has proposed interventions, it often prioritises a single outcome, such as reducing fatigue or improving coordination, without testing whether gains in one corner of the triangular state produce offsetting costs in the others. Existing interventions tend to optimise either coordination accuracy or comfort, but rarely evaluate whether these gains coexist, which leaves the central design question unresolved, namely how to support behaviour change while preserving interactional ease. The gaps identified in both contexts motivate the need for structured mechanisms that target distinct stages of interaction, which this thesis addresses through controlled experimental designs that isolate meeting phase, familiarity, and feedback timing. Chapters 3 and 4 operationalise and empirically test this stance through complementary pre-meeting and in-meeting designs. The extent to which these findings support, nuance, or limit the proposed triangular state is explicitly synthesised and resolved in Chapter 5.

Chapter 3

(Asynchronous, Unfamiliar Contexts) "Should I Introduce Myself?": Asynchronous Semi-Guided Professional Introductions (ASGPI) for Enhanced Team Effectiveness in New Virtual Teams

3.1 Introduction

As introduced in Chapter 1 and further elaborated in Chapter 2, the pandemic-era pivot to remote work has solidified virtual collaboration as an essential practice for many teams. Yet, while online platforms can be highly convenient, numerous studies (Agarwal; Morrison-Smith and Ruiz, 2020; Walther and Bunz, 2005; Wilson et al., 2006) continue to show that virtual teams often collaborate less effectively than their face-to-face counterparts. This gap partly arises from well-documented issues such as communication barriers, misunderstandings, and weaker trust (Jarvenpaa et al., 1998; Molinillo et al., 2018; Muhlfelder et al., 1999). As discussed in Chapter 2, these challenges can become especially pronounced when new members join a team without any prior in-person contact. Such circumstances reduce opportunities for the casual interpersonal cues that traditionally help people integrate into a working group (Nurmi and Hinds,

2020). Within the governing framework of the triangular state of team dynamics introduced in Chapter 1, this chapter focuses on the early formation of the triangular state of team dynamics under conditions of unfamiliarity and delayed interaction. Specifically, it examines how asynchronous, pre-meeting interventions can support trust formation and early satisfaction, and how these, in turn, shape perceptions of team effectiveness before any sustained real-time collaboration takes place. Rather than optimising task performance or interactional balance, the emphasis here is on stabilising the social foundation upon which later synchronous collaboration depends.

In response, this chapter focuses on an intervention designed to smooth the transition for new remote teammates before they hold their first synchronous meeting. Specifically, the established value of introductions is harnessed, delivered in an asynchronous format, to facilitate trust-building and familiarity. Prior research on remote collaboration (Jarvenpaa et al., 2004; Jarvenpaa and Leidner, 1999; Khvatova and Block, 2017; Norhayati and Affendi, 2020) emphasises trust as a critical factor for perceived team effectiveness (Hinds and Bailey, 2003; Hinds and Mortensen, 2005). In face-to-face settings, trust often takes root through informal chats and body language, but in virtual contexts - particularly for newly formed teams - there is typically no equivalent "hallway conversation" (Lu and Farzan, 2015; Maynard et al., 2019; Qin and Men, 2022; Kim et al., 2022). As reviewed in Chapter 2, the literature on virtual icebreakers remains relatively sparse (Jolak et al., 2018; Olsson et al., 2020), and few established formats exist for team introductions online (K. Miller et al., 2021; Zhang et al., 2023).

3.1.1 Research Questions

Building on the framework outlined in Chapter 1 and Chapter 2, the goal here is to investigate the impact of ASGPIs on perceived team effectiveness and interpersonal interaction in newly formed, globally distributed dyadic teams. The TDS is used (Wageman et al., 2005) to assess how participants gauge their collective efforts and satisfaction with interaction. Specifically, the research questions are:

- **Q1: How does having a text-based ASGPI prior to the team's first meeting affect perceived team effectiveness compared to no ASGPI?**
- **Q2: How does having a video-based ASGPI prior to the team's first meeting affect team perceived effectiveness compared to no ASGPI?**
- **Q3: How does the perceived effectiveness of a video-based ASGPI prior to the team's first meeting compare to that of a text-based ASGPI?**

Together, these questions operationalise the trust-effectiveness relationship within the triangular state, isolating the contribution of asynchronous introductions to early-stage

team dynamics. By addressing these questions, this study aims to clarify which asynchronous introduction format (if any) meaningfully enhances early trust and rapport, thus improving subsequent collaboration among dyadic teams. The next sections detail the motivations for this study's approach (Section 3.2), the questionnaire developed to operationalise professional familiarity (Section 3.3.3), the technical implementation of this study's asynchronous intervention (Section 3.4), and the user study design with which the intervention is tested (Section 3.5). The findings are then presented and discussed (Section 3.6 and Section 3.7), highlighting the role of asynchronous professional introductions in shaping initial perceptions of virtual teamwork. This insight informs the communication challenges and asynchronous strategy gaps highlighted in Chapter 2.

It is also important to acknowledge that the findings are primarily contextualised within a Western-centric perspective, and may not fully reflect the varied cultural norms shaping professional introductions globally, potentially limiting their applicability to non-Western contexts. This limitation is further discussed in Section 3.7.2. With this caveat in mind, it is proposed that the work here introduces an innovative approach to enhance collaboration and perceived effectiveness within new virtual dyadic teams. While the study focuses the dynamics of dyadic teams, the exploration of its applicability and implications for larger team configurations warrants further exploration.

3.2 Related Work

In the following sections, the related work that underpins this study's research questions is presented, approach, and overall motivation. While Chapter 2 provided a broad overview of video-based collaboration challenges, this chapter focuses on (a) how virtual vs. physical team interactions differ, (b) the unique role that dyadic teams play in facilitating or hindering trust, (c) how perceived team effectiveness arises in remote contexts, and (d) how thoughtful introductions can address the early-stage hurdles of new virtual teams.

3.2.1 Impact of the COVID-19 Pandemic on Remote Work

As introduced in Chapter 1, the COVID-19 pandemic precipitated an unprecedented global shift towards remote work, leading to new challenges and opportunities for virtual teams (Scott and Wildman, 2015). The reconfiguration of workspaces and the heightened importance of online collaboration software (Sewell and Taskin, 2015) underscore a transformation that has reshaped professional collaboration in the digital age. However, while digital platforms afford greater flexibility, they can also blur

boundaries between professional and personal spaces, fuelling issues like social isolation and Zoom Fatigue. (Waizenegger et al., 2020). Replicating spontaneous office interactions (i.e. hallway chats) in virtual settings often requires deliberate effort (Waizenegger et al., 2020), and the loss of face-to-face cues challenges knowledge-sharing (Nguyen et al., 2021). As also noted in Chapter 1, remote teams can be less effective overall than their collocated counterparts (Borup et al., 2012; Morrison-Smith and Ruiz, 2020). Such observations motivate the need for innovative strategies to nurture belonging, trust, and collaborative engagement in digital workplaces.

In parallel, the pandemic revealed how some employees thrive in remote environments while others struggle (Charalampous et al., 2019). Although online tools have proliferated (Augstein et al., 2023; Waizenegger et al., 2020), their adoption does not automatically guarantee successful virtual teamwork. Instead, carefully designed interventions are needed to sustain motivation, mitigate social isolation, and ensure effective team practices in dynamic, tech-mediated contexts. This study addresses these challenges by investigating whether asynchronous professional introductions can positively influence perceptions of collaboration and trust among dyadic teammates meeting online for the first time.

3.2.2 Interaction Challenges in Remote Work

One significant factor in bridging the effectiveness gap (as outlined in Chapter 2) is that collocated teams typically have more straightforward access to information about each other, thereby promoting trust and easing communication (Hinds and Bailey, 2003). Trust, in turn, is a cornerstone of effective teamwork in both small (dyads) and larger team structures (Yakovleva et al., 2010). Its presence facilitates information-sharing and collaboration in remote settings (Chen et al., 2014). Moreover, trust and perceived team effectiveness are tightly interwoven, especially in virtual contexts (Gibson and Cohen, 2003): even though it may not directly mirror objective performance, perceived effectiveness substantially shapes team members' motivation, engagement, and collaboration strategies. However, as highlighted in Chapter 2, establishing and maintaining trust - and thereby fostering perceived team effectiveness - can be especially difficult when face-to-face contact is absent. Recent findings even indicate that something as subtle as a participant's chosen virtual background can influence perceptions of trustworthiness (Cook et al., 2023), underscoring the importance of visual elements and non-verbal cues in remote environments.

A IEEE survey on virtual team research themes and opportunities (Alaiad et al., 2019) underscores two areas that guide this work:

1. Developing mechanisms and methods to ensure perceived team effectiveness amongst virtual team members, including dyadic teams. The dynamics within

these teams, often involving pairs of individuals, are unique and require specific attention.

2. Addressing challenges related to knowledge-sharing within virtual teams. Effective knowledge-sharing is a cornerstone of successful collaboration in virtual settings and hinges on factors like trust and communication. In dyadic teams, knowledge-sharing can be particularly influential, as it is often the primary mode of communication.

When virtual teams (including dyads) are rapidly assembled - for instance, at the height of the COVID-19 pandemic for crisis response or for quick review meetings among strangers - the usual interpersonal processes that build trust may be missing (Morrison-Smith and Ruiz, 2020; Nurmi and Hinds, 2020). This can impede timely collaboration, particularly for first-time virtual interactions (Guo et al., 2023). In dyadic teams (Breuer et al., 2020; Yakovleva et al., 2010), the absence of prior familiarity amplifies such hurdles. This study's primary objective, therefore, is to develop innovative approaches that enhance perceived team effectiveness for newly acquainted, remotely working dyad members who have no history of working together. Within this framework, trust emerges as a fundamental factor driving perceived team effectiveness, and understanding the special dynamics of dyadic structures remains crucial to nurturing meaningful collaboration in virtual contexts.

The pandemic has also prompted a re-evaluation of remote work practices, highlighting digital innovations as a means of supporting perceived team effectiveness and collaboration in a post-pandemic environment. By addressing these components - trust, perceived effectiveness, and dyadic teamwork complexities - this study aims to identify concrete strategies for improving collaboration and trust in newly formed virtual dyads. In doing so, this work seeks to mitigate the typical shortfalls that afflict remote pair-based collaboration, tackling the key issues flagged by both academic research and industry alike.

3.2.3 The Role of Dyadic Structures in This Research

As outlined in Chapter 2, particularly the subsection on dyads, dyadic interactions offer a foundational lens through which interpersonal communication and engagement can be studied in a highly focused manner. This study therefore adopts dyads - defined here as small teams of two people who share the same organisational goal (Becker and Useem, 1942) - as the central unit of analysis. Dyads are commonly encountered in day-to-day work (i.e. Andres et al. (2020); Bakeman and Beck (1974)) and are frequently examined in HCI research for their analytical tractability and relevance to collaborative systems (Chikersal et al., 2017; Derlega et al., 1993; Schuldt et al., 2017). While Chapter 2 establishes the theoretical grounding for focusing on dyads, this section elaborates on

their specific suitability for the experimental design and methodological aims of the present study.

Dyadic settings make interpersonal processes more observable than in larger groups due to differences in temporality, complexity, and intensity (Cooney et al., 2020; Hackman and Vidmar, 1970). With only one partner, it becomes easier to isolate the influence of interventions - such as asynchronous introductions - on interaction quality and trust. Responses in dyads also tend to be more intense and revealing, which aids in detecting subtle trust-related behaviours (Moreland, 1987; Swamy, 2021). As Simmel (2011) notes, dyads can undergo rapid shifts in social cohesion due to their direct one-to-one nature, heightening the need for mechanisms that can scaffold engagement.

In this context, analysing dyadic trustful interactions provides a controlled environment for exploring how trust forms, fluctuates, or fails to emerge. Prior work in small-group communication and social psychology has long highlighted dyads as fundamental to conversational dynamics, enabling a focused investigation of verbal and non-verbal cues (Liden et al., 2016; Gasiorek, 2017). Cues such as cooperative behaviour, information-sharing, and mutual vulnerability become especially salient in dyads, even without external group benchmarks.

Although most HCI research has traditionally centred on larger teams, dyads have garnered growing attention for their unique analytical advantages. Agrawal et al. (2010) identified a gap in understanding how interface design supports dyadic interaction, which more recent studies have sought to address (Chikersal et al., 2017; Schuldt et al., 2017). Compared to larger groups, dyads reduce coordination complexity, offering clearer insights into synchrony, physiological mirroring, and collaborative behaviours (Chikersal et al., 2017). Furthermore, the notion of collective intelligence is applicable not only to large teams but also to dyads (Woolley et al., 2010), suggesting that even pairs can exhibit emergent collaborative properties.

For these reasons, this study adopts a dyadic perspective to investigate perceived team effectiveness in newly acquainted virtual pairs. Larger teams undoubtedly involve additional group dynamics, yet dyads offer the clearest path to examining how professional introductions influence immediate collaboration. Critically, there remains a lack of research into how virtual dyads establish perceived team effectiveness, particularly when participants have no prior working history. By investigating structured introductions and capturing associated trust outcomes, this work provides an essential foundation for understanding dyadic collaboration - before extending the approach to larger or more complex team settings.

3.2.4 Trust and Perceived Team Effectiveness

As mentioned in Chapter 2, trust is critical for bridging the limitations of remote collaboration, addressing issues such as geographical, temporal, and psychological distance among distributed team members (Cascio, 2000; Jarvenpaa et al., 1998). It is commonly defined as a willingness to be vulnerable to another's actions based on the expectation that the other will behave reliably and beneficially (Mayer et al., 1995). Research consistently shows that trust, perceived team effectiveness, and collaboration are interlinked in a wide range of contexts (De Jong and Elfring, 2010; Cristina et al., 2018). In particular, trust can help team members - whether in-person or remote - take a "leap of faith" both individually and collectively (Dirks, 1999; Kiffin-Petersen, 2004; Pangil and Moi Chan, 2014).

S. DeOrtentiis et al. (2013) emphasise that team effectiveness hinges on a social perception: team members collectively believe in each other's ability to succeed. Although some scholars note that trust may not always correlate perfectly with performance metrics, others (especially in the virtual context) find that stronger trust can prompt higher engagement and deeper commitment to shared goals, thus elevating the group's sense of efficacy (Pangil and Moi Chan, 2014). Research also suggests that perceived team effectiveness increases motivation, as individuals feel that their contributions are meaningful and valued. According to Shortell et al. (2004), four key dimensions - (1) overall team effectiveness, (2) team skills, (3) participation and goal agreement, and (4) organisational support - can shape how members gauge their team's potential and progress.

Since 2010, Liu et al. have highlighted how trust interacts with multiple components of perceived effectiveness in newly formed or remote teams. These interactions are often influenced by closeness or interpersonal dynamics that develop over time (Dangmei, 2016). By focusing on trust and perceived team effectiveness early in a group's lifecycle, teams can more easily develop deeper interpersonal bonds over time (Dangmei, 2016). In other words, paying close attention to trust-building during the initial stage can create a virtuous cycle that fuels greater collective confidence, readiness to share ideas, and resilience in problem-solving.

Despite widespread recognition of trust's importance, many virtual teams discuss it only in abstract terms and lack concrete strategies to strengthen it - or to enhance perceived team effectiveness. Molinillo et al. (2018) argue that there is a pressing need for more hands-on interventions that support both. Accordingly, this work proposes ASG-PIs as a mechanism for newly assembled professional teams to foster trust quickly. By focusing on perceived team effectiveness as an observable outcome (Costa et al., 2001; S. DeOrtentiis et al., 2013), the introduction process is linked directly to trust-building benefits. The hypothesis here is that when teammates see each other as approachable and competent from the start, they become more willing to share resources, voice concerns, and commit to the group's objectives.

3.2.5 Introductions

Establishing trust and perceived team effectiveness in virtual teams depends not just on ongoing interactions but also on early-stage team formation (Paul et al., 2016), as discussed in Chapter 2. This critical phase often begins with introductions (Coppola et al., 2004), which have been shown to reduce uncertainty and stress in social contexts (Dandeneau et al., 2007; Gunnar and Donzella, 2002; Levine et al., 1997). Such introductions serve various purposes, including initiating conversations (Indrayanti, 2014), shaping impressions in work settings (Hinds and Mortensen, 2005), and clarifying collaboration norms (Hinds et al., 2000). The information shared at this point helps individuals gauge their community and evaluate teammates' trustworthiness through multiple cues (Rusman et al., 2013b; Yang et al., 2023). Schumann et al. (2017) further demonstrate that virtual contact designed to heighten social presence can reduce prejudice, implying that similar strategies in professional online introductions could lead to better initial perceptions and thus strengthen team effectiveness. However, although introductions can be vital icebreakers, limited HCI research has examined how to systematically design them in virtual teams, particularly to help relative strangers connect efficiently.

Overview of Introductions as Icebreakers

Icebreakers refer to common group activities or rituals that facilitate a more comfortable start to interactions, often aiding trust formation (Alitolppa-Niitamo, 2004; Depping et al., 2016; Indrayanti, 2014; K. Miller et al., 2021; Tan and Cox, 2019). In one example, K. Miller et al. (2021) studied synchronous, video-based icebreaker introductions and found a reduction in anxiety for participants who had never met. However, further research is needed on structuring virtual team introductions - particularly in asynchronous modes - to capitalise on trust-building and promote perceived team effectiveness Rocco et al. (2000); Knowles et al. (2015). Additional investigation is also warranted into the potential for curated or misleading self-presentations in digital contexts (Schlosser, 2020). This study builds on these insights by offering guidance on how to craft meaningful professional introductions specifically suited for early collaboration in a virtual environment. Since first-time meetings lay the foundation for trust and perceived team effectiveness, it is especially important that these opening encounters be carefully designed.

Berger and Calabrese (1975) suggest people naturally feel compelled to introduce themselves to reduce social unpredictability. In a more recent examination, Pillet-Shore (2011) observed that in professional meetings, a "mediator" can expedite the process by presenting essential details about participants. Without such mediation or guidance, introductions can vary widely - sometimes providing too little or too much information, which might inadvertently raise uncertainty (Fontaine, 2012; Sacks, 1992;

Searle, 1958). For instance, simply stating one's name may not convey significant identity cues (Pillet-Shore, 2011). Consequently, if introductions remain purely ad hoc, they risk either failing to establish rapport or imposing awkward social encounters, both of which can hinder collaboration and reduce trust development.

Introductions Through Self-Disclosure: Using Asynchrony

Self-disclosure involves intentionally revealing personal or background information about oneself (Molinillo et al., 2018). Traditionally, it focuses on accuracy rather than impression management (Johnson, 1981; Laurenceau et al., 1998), whereas self-presentation selectively shapes others' views (Derlega et al., 1993; Schlosser, 2020). In virtual settings, self-disclosure can be especially valuable for fostering trust, impression formation, and familiarity (Hinds and Mortensen, 2005; K. Miller et al., 2021; Mendenhall et al., 2017; Nurmi and Hinds, 2020). This study adopts a broad view of self-disclosure as the sharing of both objective facts (i.e. professional background) and personal experiences (including vulnerabilities or past mistakes). By prompting participants to reveal pertinent details up-front - rather than waiting for them to emerge unpredictably - the goal is to strengthen familiarity, trust, and effective collaboration from the outset.

Notably, self-disclosure may emphasise different information depending on the interaction's goals and context (Johnson, 1981; Schlosser, 2020). While some introductions highlight professional competence, others can encompass more personal emotions or experiences. Regardless, this multifaceted process can help avert conflict, build rapport, and enhance overall collaboration by offering teammates insight into each other's capabilities and challenges (Hinds and Mortensen, 2005; Mendenhall et al., 2017). Focusing on self-disclosure in the earliest stage of team formation is particularly relevant for newly formed virtual teams, as it can jumpstart the trust needed to improve perceived team effectiveness. The investigation thus explores how participants might leverage self-disclosure - ranging from professional background to personal anecdotes - to establish a stronger sense of familiarity and mutual support.

Schlosser and others (Bargh et al., 2002; Schlosser, 2020) have examined how social environments predict intentions and shape self-disclosure. Asynchronous settings often prove more conducive to open, authentic sharing than face-to-face meetings, partly because factors like perceived attractiveness or real-time social pressure play a lesser role (Molinillo et al., 2018; Muhlfelder et al., 1999; Thomas et al., 2017). By allowing team members to disclose professional information before meeting "live", asynchronous contexts can help newcomers gain early insight into the group, fostering trust and encouraging the exchange of work-related background details. Within this study, it is tested whether professional introductions (in text or video format) can enhance both perceived trust and team effectiveness - particularly in unfamiliar dyadic teams that might otherwise struggle to build rapport quickly.

Delivery of Introductions: Semi-Guided

This study addresses the challenge of creating professional impressions in virtual contexts by examining comprehensive measures of first-impression formation that can support long-term collaboration, with particular attention to perceived team effectiveness and trust. Recent work indicates that different media - ranging from images and text to video cues - can significantly affect trust-building during initial impressions, even if these studies were conducted in varying settings (van der Zanden et al., 2022; Yang et al., 2023). While some prior research has explored trustworthiness and deception in first impressions, there remains a noticeable gap in the literature regarding icebreaker activities specifically designed for initiating and sustaining professional relationships online.

Adding to the range of possible methods for orchestrating introductions, Shin et al. (2023) show how chatbots can enhance trust and cohesion through guided interactions during the familiarisation phase of virtual teamwork. HCI research has likewise investigated the use of games as effective icebreakers, underscoring their potential to replace or augment traditional conversation starters. Yet, users may also misuse features such as audio self-presentations on these platforms, highlighting the need for guidance in their effective application. In response to these gaps, the present study examines how semi-guided introductions can influence key personality traits - such as agreeableness - that warrant further exploration (Drouin et al., 2016; Guillory and Hancock, 2012; Toma et al., 2018). This study's approach relies on pre-recorded semi-guided interventions grounded in first-impression formation scenarios, including competence, commitment, availability, and communality, as identified by Hinds, Rusman, and Hancock. By adopting these targeted prompts, this research aims to shed light on how structured, yet flexible, professional introductions can foster both trust and sustained collaboration in newly formed virtual teams.

Introduction Content: Professional Familiarity

Maynard et al. (2019) identified five core attributes of professional familiarity: Competencies, Reputation, Work Performance, Dependability, and Attention to Detail. When teammates are aware of each other's relevant skills and background, they tend to share information more freely and trust each other's contributions (Lu and Farzan, 2015; Maynard et al., 2019). Although the notion of "familiarity" in HCI is relatively recent, one emerging example is the chatbot-based approach by Shin et al. (2023), designed to improve interpersonal processes through guided discussion of professional roles and experiences. Similarly, professional self-disclosure - whether in an asynchronous video or text format - can convey competence and a willingness to be known, thus reducing uncertainty and encouraging trust before the first live interaction (Derlega et al., 1993; Hinds et al., 2000).

Beyond these immediate benefits, cultural diversity also shapes how introductions unfold. As Jayanthi and Rajandran (2014) note, cross-cultural differences can influence

team communication and cohesion, which in turn affect team effectiveness. While the work presented here adopts a Western-centric approach to ASGPIs, future research could explore how different cultural norms or professional etiquette practices further refine or complicate asynchronous introduction strategies. By examining how professional familiarity fosters early trust in dyadic teams, this study offers a foundation for adapting similar methods in broader, more diverse virtual settings.

3.3 Apparatus: ASGPI and the Professional Familiarity Questionnaire

This section describes the apparatus developed to explore the aforementioned research questions and gain insights into the impact of ASGPIs on perceived team effectiveness. This approach operationalises the attributes of professional familiarity into constructing asynchronous, semi-guided introductions for professionals.

3.3.1 Deconstruction in HCI as a Design Technique

Alan Dix's Deconstructing Christmas Crackers (Dix, 2018) has inspired this study's approach. Rather than attempting to replicate physical introductions in online settings (as is typically done), the characteristics of effective introductions were analysed based on research and it was consciously considered how to translate these experiences to digital media and interactions. Previously, desktop interfaces tended to mimic the appearance of physical objects rather than focusing on the interaction qualities. For instance, notebook interfaces imitated the look of paper (such as lines on pages and covers on "books", what Dix calls "Surface Elements") rather than prioritising the convenience of quick note-taking (the "experience effects") that pen and paper offer (Dix, 2018). Dix refers to this approach as "digital reconstruction not reproduction". Using this Deconstruction of the Physical towards the Reconstruction in the Digital, ASGPI was created.

3.3.2 ASGPI

Computer-mediated communication provides the unique advantage of flexible time management, which is leveraged through ASGPIs. ASGPI offers a departure from traditional in-meeting introductions, eliminating the need for individuals to allocate valuable meeting time for this purpose. ASGPI is thoughtfully designed to afford individuals the time and space necessary for self-disclosure and reflection, recognised as pivotal aspects of effective team building (Altschuller and Benbunan-Fich, 2013; K. Miller et al., 2021). Furthermore, this study's innovative approach facilitates introductions outside

the constraints of meeting contexts, enabling team members to genuinely engage with and absorb their colleagues' self-disclosures.

Informed by K. Miller et al.'s research on perceived team effectiveness, which underscores the significance of structured introductions, the study integrates a semi-guided approach within ASGPI. This approach aims to address the common challenge of spontaneous self-disclosure and unstructured icebreakers that can create uncertainty, particularly in dating situations, while maintaining relevance within a professional context. Within the ASGPI process, participants are semi-guided through a predetermined set of questions. The use of pre-recording empowers participants to rehearse their responses within the allotted time for each question, providing them with the opportunity to refine their introductions. Ths work is also investigating whether the time limits for responses can serve as social equalisers, ensuring that every team member has an equitable chance to participate.

Drawing on previous research that emphasises the importance of professional experience as a means of building team trust (such as Maynard et al.'s work), the questions in ASGPI are centred on five professional attributes. This questionnaire is refered to as the Professional Familiarity Questionnaire.

3.3.3 Professional Familiarity Questionnaire

This study's objective in formulating the questions to guide the introductions was twofold. First, this work aimed to support the "multi-dimensional nature of familiarity" (Espinosa et al., 2007), which refers to the idea that social identities are communicated through "self-categorisations" that contribute to the development of knowledge about a person and can have a positive impact on perceived team effectiveness. Second, according to research, building professional familiarity also fosters confidence in team members about each other (such as in Lu and Farzan (2015) and Maynard et al. (2019) studies). To create the questionnaire, this study drew heavily on Maynard et al. (2019)'s work on the key attributes of professional familiarity detailed in Section 2.4. Building on this structure, relevant research was integrated (Aharoni and Nachum, 2000; Hasim, 2019; Hoevemeyer, 2017; Simcic Brønn, 2007) to formulate the set of questions presented in Table 3.1.

TABLE 3.1: The Professional Familiarity Questionnaire is based on the five key attributes of professional familiarity, comprising of a set of questions each: competencies, reputation/integrity, work performance, dependability, and attention to detail. These questions are adapted from various sources in the literature to comprehensively evaluate professional familiarity.

Attributes of Professional Familiarity	Questions	Adapted From
Competencies	Can you tell me about a situation where you had to collaborate with others in order to solve a numerical task? (i.e. solving a mathematical problem, coding competition, puzzle, logical activity, etc.) Who was involved in it? (i.e. software team, friends, classmates, etc.) Where and when did this situation occur? (i.e. a situation at work, an activity, in school, etc.) How did you do it? What was the result? (i.e. split the work, work in shifts, which led to receiving awards/gaining experience, etc.)	Hasim (2019)
Reputation/ Integrity	Can you tell me about an achievement on a task assessing your interpretation/problem-solving skills? (i.e. in a competition, game, etc.) How was this achievement perceived by the others? (i.e. your team members, the jury, your circle of friends etc.) If people who have previously worked with you in a team could characterise you by 3 attributes, which would they be? (personality-wise)	Aharoni and Nachum (2000)
Work Performance	Tell me about a time when you were not as effective as you would have liked in managing a team's problem-solving work. How would you improve that? (i.e. time managing problems, work assessment, contribution, etc. and how you would change that)	Hoevemeyer (2017)
Dependability	Tell me about the measures you use to keep informed of your activities, achievements, progress towards objectives (i.e. calendars, software programs, notes, etc.).	Hoevemeyer (2017); Simcic Brønn (2007)
Attention to Detail	Give me an example of a time when your attention to detail helped you avoid making a mistake or helped you catch an error that others have missed (i.e. in a coding task, in solving a puzzle or mathematical problem, activity, etc.)	Hoevemeyer (2017)

By using the Professional Familiarity Questionnaire, the key aspects of professional familiarity were incorporated, with an emphasis on participants sharing positive experiences and lessons learned. This approach aligns with prior research that underscores the significance of positive self-disclosure in fostering perceived team effectiveness, trust and successful collaboration within teams (Sand, 2020; Dee et al., 2002; Assmann and Gallenkamp, 2009; Posey et al., 2010). This study's questionnaire primarily focused on soliciting narratives related to positive experiences, including one item from the Work Performance section, that prompted participants to reflect on how they transformed a negative experience into a valuable lesson and personal growth. This unique focus is based on literature which highlights the constructive influence of positive storytelling and its role in cultivating trust and interpersonal processes within teams (Auvinen et al., 2013; Tesler, 2011; Tesler et al., 2018). Prior studies have suggested that emphasising positive stories can be instrumental in creating a supportive atmosphere during the initial stages of team formation, promoting open self-disclosure, and ultimately enhancing perceived team effectiveness (Kozlowski and Ilgen, 2006; Kozlowski and Bell, 2003; Menabney). By centring the questionnaire on positive experiences, this research aimed to encourage participants to share insights and experiences that could contribute positively to team dynamics. Thus, by utilising professional profile templates, meeting participants can evaluate the trustworthiness of their colleagues based on the information presented in their introductions. This insight informs the development of an artefact that facilitates the formation of trust during the initial stages of virtual team collaboration, an area that has not yet been thoroughly explored in the literature (Rusman et al., 2013a), and forms the experimental foundation for the user study presented in Section 3.5. Furthermore, the questions in the Professional Familiarity Questionnaire were intentionally designed to be broadly applicable across various fields, work departments, and personalities, providing participants with the flexibility to select situations that align with their unique professional backgrounds. Here, the questionnaire's umbrella terminology (i.e "numerical task") encompasses a wide array of activities, including problem-solving in work-related contexts, as well as in other circumstances (i.e. sports or games), ensuring inclusivity and relevance for a diverse range of experiences.

In summary, this study leverages digital affordances - including asynchrony, structured guidance, response rehearsal, and time-limited recordings - to support a flexible introduction process intended to enhance perceived team effectiveness prior to task-oriented meetings.

3.4 Implementation of the ASGPI System

The following implementation details correspond directly to the asynchronous platform outlined in Section 3.3. In this section, the technical foundation and design choices

underlying this study's asynchronous introduction system are detailed, explaining not only the overall architecture and software stack, but also how these elements come together to support video- and text-based introductions as part of the user study. The goal was to create a robust, reproducible environment where participants were able to record, store, and review introductory content prior to their first remote meeting.

3.4.1 High-Level Architecture

The implementation follows a multi-layer design to accommodate the different needs of the study:

1. **Front-end (Next.js)** – A framework that builds on React (a JavaScript foundation for building user interfaces), used for creating dynamic user interfaces and server-side rendering. It handles participant logins, displays each user's introduction, and orchestrates the overall flow.

2. **Back-end microservice (GraphQL Upload Service)** – A Node.js-based server that uses Apollo Server and `graphql-upload` (a middleware package for handling file uploads in GraphQL APIs) to handle the management of asynchronous video uploading, partial file streaming, and retrieval. It serves as a separate microservice to ensure the upload logic and file streaming can scale or be modified independently.

3. **Database layer (PostgreSQL + Prisma)** – Data is stored in a PostgreSQL database, which runs inside a Docker container to simplify setup and ensure environment consistency. Prisma, a schema-driven Object-Relational Mapping tool, provides a clean abstraction for reading and writing to the database across multiple entities (i.e. `Introduction`, `File`, and `User`).

4. **Data analysis pipeline (Python)** – A suite of Python scripts handles the research-specific computations - particularly the TDS metrics and performance analysis. This code is separate from the main application for re-use.

5. **Deployment (Production-first):** The complete system was deployed to production at *intros.wellthlab.ac.uk* using a Docker-based container orchestration model. The PostgreSQL database, GraphQL server, and Next.js front-end were hosted in separate containers, coordinated via Docker Compose. NGINX, a lightweight open-source web server, was used to serve static files and proxy traffic securely to the GraphQL backend. This live setup ensured reliable and secure access for participants to record and view introductions throughout the study period.

All these layers are loosely coupled: the front-end communicates with the GraphQL layer for uploads and retrieval, the GraphQL layer interacts with PostgreSQL for storage, and the Python scripts read participant data (CSV outputs, logs, and so on) to generate quantitative findings about trust, collaboration, and team effectiveness.

3.4.2 Deployment Setup and Development Environment

All participant sessions were conducted via a live production deployment at `intros.wellthlab.ac.uk`. This hosted system served as the sole environment for collecting real-world study data. The deployment architecture included Docker-based orchestration of PostgreSQL, the GraphQL server, and the Next.js front-end, with NGINX handling HTTPS routing and static content delivery. This setup ensured persistent availability and data integrity during asynchronous usage.

A local development environment was also maintained in parallel for testing and system iteration. Docker and `docker-compose` were used to replicate the production setup, enabling consistent configuration across machines. This allowed collaborators to preview changes, simulate uploads, and validate the system architecture before deployment. The local setup included the following sequence:

1. **Initialise the database with Docker:** Launches a PostgreSQL container on port 5433 using defined credentials and volume mapping;
2. **Start the GraphQL server:** Runs on `localhost:4000`, handling video uploads and streaming via range requests;
3. **Run the front-end:** Accessible at `localhost:3000`, enabling interface testing with Next.js and authentication logic.

This environment was used solely for internal development. All study data, participant interactions, and logged activity were collected through the production-hosted system.

3.4.3 Back-End Implementation Details

GraphQL File Upload Flow

In the `graphql-upload` folder, Apollo Server is integrated (an open-source GraphQL server) with the `graphql-upload` package to support multipart file uploads, critical for capturing participants' asynchronous video introductions (each answer which constitutes a separate video). The essential elements include:

- **GraphQL Schema (typeDefs):** A custom `Upload` parameter is defined alongside a `File` type that describes the uploaded object.
- **Resolver for `Upload` (`singleUpload`):** Takes the file from the front-end and pipes its binary stream to the local directory, generating a short unique identifier for the filename and returning metadata.
- **Video Playback:** An Express handler at `GET /video/:fileName` leverages HTTP range requests so that large files can be streamed incrementally (instead of forcing participants to download an entire MP4 in a single request).

This microservice design was chosen so that the rest of the application (especially the front-end) never has to deal with the complexities of partial file streaming. As a result, any user's introduction can be played back simply by embedding a `<video>` element pointing to `http://localhost:4000/video/<my-file.mp4>` for watching the ASGPI.

Prisma and PostgreSQL

Prisma was used for:

- **Defining schemas:** having tables like `Introduction`, `File`, and `User`. For instance, the `Introduction` table references the participant who authored the introduction and a list of associated video-`File` records.
- **Generating migrations:** relying on the "`npx prisma db push`" command to reflect any schema updates in the local or located Postgres instance.
- **Server-side retrieval:** when a participant logs in, the system can fetch or create new `Introduction` records, attach `File` metadata, and so on, through Prisma's API.

This simplifies the addition or removal of data models (i.e. for handling video and text-based introductions separately) while maintaining a consistent approach to data storage.

3.4.4 Front-End Implementation Details

Next.js + React

On the frontend, Next.js was chosen to streamline:

- **Server-side rendering:** Allows for quicker page loads and better search engine optimisation, although it is tangential in this user study.

- **API Routes/Server Side Rendering:** Allows for quicker page loads and better search engine optimisation, although it is tangential in this user study.

The pages/directory contains typical Next.js entry points:

- `index.js`**:** The home page with sign-in prompts.
- `profile/[id].tsx`**:** A dynamic route that handles user introduction display or editing. The dynamic segment is parsed as a "type" parameter and passed to the Profile component.

User Authentication

Security-wise, to ensure only authorised participants record or view videos, `Next Auth` is integrated with session tokens securely stored in the database and authentication handled via secure email-based sign-in.:

1. Email or provider-based sign-in, storing the session tokens in the database.
2. A higher-order component (`AuthWrapper`) that redirects unauthenticated users to log in before accessing restricted pages (i.e. the introduction creation screen).
3. This approach simplifies the study's setup because each participant can log in via a secure link, create their introduction, and then optionally share the link with a partner.

Recording & Uploading Videos

Some participants might record videos directly in the browser (i.e. using `navigator.mediaDevices`) and then call the GraphQL function `singleUpload(file: Upload!)`:

- **Front-end:** A simple React component obtains the raw file from a user's local device or from an in-browser capture.
- **Apollo client:** Configured with `createUploadLink()` to handle multipart form data.
- **Upload:** The file is posted to the GraphQL endpoint. The microservice writes it into the corresponding folder.
- **Confirmation:** On success, the user sees a preview URL or a success message.

In parallel, text-only introductions are also supported for participants who prefer not to record a video. Their typed content is submitted via typical GraphQL or REST endpoints and stored in the database. This design flexibility ensures the study can compare text-based vs. video-based introductions under uniform conditions.

3.4.5 Data Analysis & TDS Scripts

A key part of the research is to quantify the effect that asynchronous introductions have on trust, rapport, and perceived team effectiveness. Hence, a separate set of Python scripts is maintained for offline data analysis:

- **TDS Computations (i.e. `group_satisfaction.py`):** These scripts allow as inputs CSV files containing each participant's responses to the TDS. They apply reverse-scoring logic, subdimension breakdown (Effort-Related Process Criteria, Strategy-Related Process Criteria, etc.), and then compute a final TDS metric.
- **Performance Measurements (i.e. `performance_analysis.py`):** For tasks such as "incremental" vs. "insight" puzzles, the scripts check how long it took participants to complete them and whether the answers were correct. Statistical tests are then run to see if video or text-based introductions correlated with faster completion times or higher accuracy (see the Results section below).

Since these scripts are purely for evaluation, they do not run within the main Next.js or GraphQL services. Instead, periodically, the participant logs or responses are exported to CSV, are run locally, and the results that feed into the final analysis of trust-building efficacy are produced.

3.4.6 Design Rationale & Benefits

1. **Microservices approach:** The upload/streaming service is isolated so the front-end remains lightweight. This arrangement allows each part of the system (front-end, file server, database) to be updated or scaled without affecting the others.
2. **Docker for simplified deployment:** By managing the database and back-end services, each collaborator or researcher can replicate the environment precisely, avoiding library version mismatches.
3. **Prisma + PostgreSQL:** Prisma's schema-based approach made it straightforward to keep track of new relationships (i.e. multiple videos per participant, newly introduced data fields) and to guarantee type safety across the stack.
4. **Asynchronous video playback:** The chunked streaming route significantly improves participant experience. People with lower bandwidth can still watch their dyad's introduction in real-time, instead of waiting for a large file to download.
5. **Text vs. Video ASGPI:** Implementing both approaches was essential for comparing conditions. Videos have richer presence cues, but text-based ASGPIs can be more concise or feasible in low-bandwidth regions.

6. **Separate data analysis:** Keeping the research scripts out of the production codebase guards performance and prevents the Python libraries from complicating Node.js deployments. It also enforces a clear boundary between the study environment (introductions, participant tasks) and the analysis environment (TDS, performance metrics).

3.4.7 Summary of Implementation

Overall, the system integrates a web-based approach to capturing and sharing asynchronous introductions prior to remote team meetings. Next.js is used for the interface, `graphql-upload` for robust file handling, Docker + PostgreSQL for persistent data storage in the production environment, with mirroring for local development, and a Python pipeline for analysing TDS results and performance metrics. This end-to-end pipeline not only supports the controlled user study environment needed for investigating trust and perceived team effectiveness, but also generalises well to real-world use cases where video introductions can significantly streamline the "getting to know you" phase in remote collaboration.

This modular implementation (spanning front-end user experiences, specialised backend microservices, and a standardised data pipeline) forms the backbone of the experimental setup, ensuring that participants could securely record or provide introductions via the production system and that it's possible to capture the data needed to evaluate the hypotheses. This pipeline forms the foundation for the experimental procedures detailed in the next section (3.5).

3.5 Study Design and Methodology

Introductions in new virtual dyadic teams are explored via three conditions: video-based ASGPI (VC), text-based ASGPI (TC), and no ASGPI (NC), where participants provide their introductions through the Professional Familiarity Questionnaire. Participants were allocated to dyadic teams for this study. The study was structured into four distinct stages: Onboarding, Pre-Meeting Preparation, the Zoom Meeting, and the Post-Experiment Survey. A diagram illustrating all phases of the experiment can be found in Figure 3.2 at the end of this section. The subsequent sections will delve into each of these stages, providing a comprehensive description of the study design, the rationale for the methodological choices, including participant recruitment, study setup, ASGPI creation, collaboration tasks, data analysis, and the nature of the survey instrument.

3.5.1 Recruitment and participants

28 dyads are enrolled, comprising of 17 females, 26 males, and 13 participants who did not specify their gender, with ages ranging from 21 to 60 years (Mean = 33 years, Std. Dev. = 12.06 years). The recruitment of participants was carried out globally to ensure a diverse range of geographical locations and experiences, contributing to a rich and varied participant pool, whilst the recruitment process was structured based on specific criteria. Prospective participants initiated the process by completing a detailed questionnaire that solicited information on demographics, professional expertise, and geographical location. This initial questionnaire played a vital role in shaping the participant allocation and distribution strategy, ensuring a well-rounded and heterogeneous participant pool. The participants were required to be currently employed and have experience in office settings, underlining the professional context essential for the study. Proficiency in English for work purposes was also a prerequisite, given that English was the primary language of communication in the study. Importantly, participants should have no prior knowledge of each other, meaning they have never worked together or been part of the same organisation. This criterion was followed to eliminate any pre-existing relationships or biases amongst participants, as it could impact the dynamics of trust development during the study. At the same time, participants had no prior acquaintance with the experimenters responsible for running the study's virtual meeting. These criteria were met by the pairing process, which will be elaborated upon in the subsequent sections. By engaging participants through an initial questionnaire, not only it is ensured that they met the study's specific requirements but also set the stage for their allocation and distribution into dyads.

This study received ethical approval from the University of Southampton Ethics Committee (ERGO/FEPS/56029.A2). Participants were provided with a detailed Participant Information Sheet and gave informed consent prior to the study. A copy of the Participant Information Sheet is included in Appendix A.1.

3.5.2 Study Set-up and Participant Pairing

A between-subjects design was adopted for the study, wherein participants were randomly assigned to one of three distinct introduction conditions, each designed to examine the impact of varying introduction formats on trust development within newly formed virtual dyadic teams.

1. **VC:** In this condition, dyads utilised ASGPI with video-format introductions. Participants followed a structured process of providing their introductions through video, with specific guidelines for video and sound quality to ensure a consistent experience.

2. **TC:** Participants in this condition engaged in ASGPI using text-based introductions. They were provided with clear instructions on how to craft their introductions in written format, with a predefined word limit for each question, promoting a textual approach to self-disclosure.

3. **NC:** Participants in this group did not have a structured ASGPI process, and no specific guidance, encouragement, or recommendations were provided on how to introduce themselves.

The objective was to investigate the influence of ASGPI on perceived team effectiveness compared to no ASGPI and to assess which communication channel, either video or text, best enhances this metric within virtual dyadic teams. The participant pairing strategy was based on the information provided in the questionnaire, to allow for pairing individuals with distinct professional experiences, diverse geographical locations, and differing work profiles. Experimenters played a crucial role in facilitating the meeting and guiding participants through tasks, following a standardised protocol.

This design allowed for the investigation of how the nature of the introduction format – video or text – impacted perceived team effectiveness development in virtual dyadic teams, as well as analyse the effectiveness of ASGPI against no structured introduction. It also facilitated a focused assessment of the unique effects of each format on trust dynamics. This study is therefore positioned as a feasibility-oriented evaluation of ASGPI in its intended context, unfamiliar dyads, rather than as a full factorial test across familiarity conditions, which would be required to assess cross-context generalisability.

3.5.3 Creating the ASGPI

ASGPI allowed participants to create, asynchronously, detailed professional introductions about themselves in a semi-guided manner. This approach aimed to foster a better understanding of each participant's professional background thereby facilitating perceived team effectiveness and trust development in newly formed dyadic teams. Two days prior to the virtual meeting, participants who were assigned to complete an ASGPI were emailed a link to access and complete the necessary steps for uploading their introductions. Participants in the NC Condition did not have an introduction, and they received no specific guidance or recommendations on how to introduce themselves. Instead, they were informed solely of the meeting date and time.

Participants in the VC were provided with a link to a portal that was built for the purpose of this study (with implementation described in Section 3.4), where they could record their introductions. They were instructed to follow specific guidelines to ensure optimal video and sound quality. Each question within the ASGPI process was timed differently, with a maximum of 1 min per question available, to maintain consistency

and keep the process efficient. Additionally, guidance to participants was provided on lighting and background considerations to optimise the video recording conditions for the best possible outcomes. A screenshot of the user interface for the VC participants is presented in Figure 3.1

TC participants were given access to the same designated portal through a provided link, where they composed their introductions in a written format. They were presented with the same set of questions as VC participants. Here, participants were instructed to answer each question with a maximum of 100 words per response. This allowed for uniformity and standardisation to be maintained in the text introduction process, ensuring that participants had equal opportunities to present themselves succinctly and effectively.

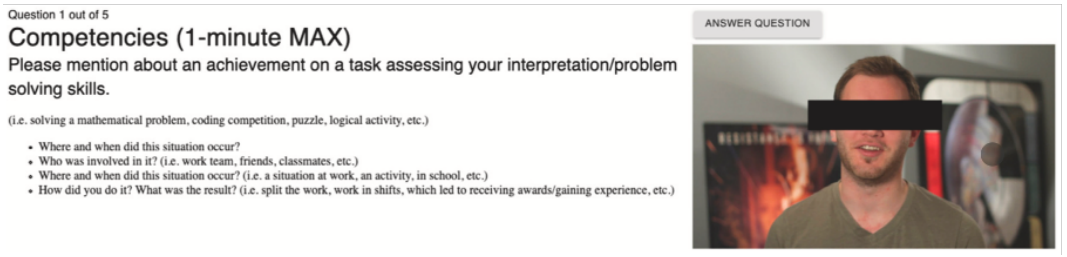

FIGURE 3.1: Participant using our platform to record their video-based ASGPI.

All participants had the flexibility to edit their answers as many times as they desired before moving on to the next section. This feature allowed them to re-record or revisit previous questions to refine their responses as needed. Once they were satisfied with their introductions, they could proceed to the next section. Upon completion of the entire set of questions, participants submitted their introductions, which were then sent to us. Furthermore, participants were explicitly informed that the introductions they created would be shared with their new team member, with whom they were slated to collaborate in an upcoming video conference. In addition to this, participants were also informed that they would receive the introduction of their assigned team member in advance of the scheduled meeting.

3.5.4 Virtual Video Meeting

Participants in both text-based and video-based conditions were sent the link to view or read their team member's introductions 15 min prior to their scheduled video conference. To simulate a globally distributed team, timezone differences were not a confounding factor, and the conference was scheduled at a convenient time. To ensure visibility consistency, all participants, regardless of the condition they were in, received guidelines on lighting.

At the start of the video conference, participants were introduced to the meeting's structure and the collaborative problem-solving tasks by the experimenter. Additionally, to confirm that participants had no prior knowledge of one another, the experimenter inquired at the beginning of the experiment whether participants had previously worked together or collaborated. The experimenter maintained the camera off throughout the study and delivered instructions to participants via audio at the commencement of the video conference, followed by communication through the text chat interface for the duration of the collaborative problem-solving tasks. These six tasks, comprising three insight and three incremental problems, were adapted from a problem-solving assessment conducted by Jun et al. (2019), as listed in Appendix A.2. It is important to note that these tasks were intentionally designed to investigate the intricacies of dyadic teamwork, with an emphasis on communication's role in trust-building, rather than being primarily focused on task performance. The intent in selecting these tasks was to encourage collaboration, effective communication, and critical thinking amongst participants, simulating real-world challenges they might encounter when forging professional relationships with new colleagues.

Both insight and incremental problems were incorporated due to their established significance in evaluating convergent creativity and cognitive abilities (De Bono, 1995; Dominowski, 1995). Insight problems were included to assess participants' capacity for generating innovative and practical solutions, often necessitating "lateral thinking" (i.e. If you have black socks and brown socks in your drawer, mixed in a ratio of 4 to 5, how many socks will you have to take out to make sure that you have a pair the same colour?). In contrast, incremental problems, reminiscent of algebraic reasoning, require the application of specific rules or strategies to arrive at a solution (i.e. Ann is twice as old as her son. They were both born in June. Ten years ago Ann was three times as old as her son. What are their present ages?). This choice to incorporate a variety of problem types was informed by established research (De Bono, 1995) and aimed to provide a comprehensive assessment of participants' creative and cognitive competencies within the context of trust development in virtual teams.

Tasks that would be accessible to participants were designed from various cultural backgrounds, yet it is important to recognise the possibility of cultural biases influenced by a Western-centric view. Future iterations of this research could seek to more comprehensively account for cultural differences in task design. During the video conference, participants were permitted to use pen and paper for problem-solving if they wished. They were instructed to submit their answers in the meeting chat within four minutes of receiving each problem, and a timer countdown was provided through the video conference interface. To avoid influencing participants' perceptions of team collaboration, no feedback on task accuracy was given during the video meeting.

3.5.5 Post-study survey: Assessment Instrument for Perceived Team Effectiveness

To assess the perceived team effectiveness in the study, the TDS was employed as part of the research methodology, in line with established research conventions (Bos et al., 2002; Furst et al., 1999; Wageman et al., 2005). Perceived team effectiveness was evaluated using a subset of the TDS, focusing on the Team Effectiveness Process Criteria. This subset comprised of three sections (Effort-Related Process, Strategy-Related Process, Knowledge and Skill-Related Process), containing nine questions drawn from the TDS (Wageman et al., 2005), as listed in Appendix A.3. The chosen questions were designed to assess critical dimensions within this sub-scope, including the level of effort expended by team members on the task, the quality of team task performance strategies, and the effective utilisation of member knowledge and skills within the team. The choice of using the TDS was based on its comprehensive evaluation of team dynamics and team effectiveness, which are integral to fostering trust development and overall team satisfaction (Wageman et al., 2005). It was chosen for its ability to gauge multiple dimensions of team effectiveness and capture the interactions that emerge during the early stages of virtual team formation. The survey's design allows for the evaluation of the development of perceived team effectiveness and trust, which remain vital for exploration in smaller team contexts (Paul et al., 2021). The choice of TDS was also reinforced by its suitability for small-sized teams, which aligns with the group tasks employed in the study, including insight and incremental tasks adapted from Jun's work. These tasks were carefully crafted to promote task-focused effort and effective teamwork, resonating with the principles of task design highlighted by Hackman (1980). Moreover, TDS's ability to assess team composition and diversity, emphasising the need for team members with complementary skills and the ability to communicate and coordinate effectively, was consistent with this study's goal of evaluating perceived team effectiveness within dyadic teams. By adapting it to the study's context, it is aimed to shed light on the relationship between communication efforts and trust-building in virtual dyadic teams.

The "Process Criteria of Team Effectiveness" subdimension of the TDS was selected due to its strong connection to overall team effectiveness and its ability to gauge essential aspects of team interaction and performance (Wageman et al., 2005). Participants provided ratings for statements such as "Team members actively share their specialised knowledge and expertise with one another" or "Our team encounters challenges in implementing the plans we formulate for task progression". These responses were recorded on a five-point scale, ranging from "highly inaccurate" (1) to "highly accurate" (5). Given that perceived team effectiveness is fundamentally a collective measure, the team's mean scores were calculated for these adapted TDS questions. Data

analysis and the production of results tables were conducted using the statistical software tool SPSS. One-way ANOVA was used and conducted Tukey's HSD Test for post-hoc multiple comparisons to assess the TDS data. At the conclusion of the survey, participants were also presented with a set of qualitative open-ended questions, designed to elicit their insights and reflections on the intervention, collaborative experience, and overall impressions of the virtual team meeting. Qualitative data were extracted from both meeting interactions and the post-study questionnaires at the conclusion of the study underwent a thematic coding process. This involved a detailed examination of participant responses to identify recurring themes, patterns, and meaningful insights.

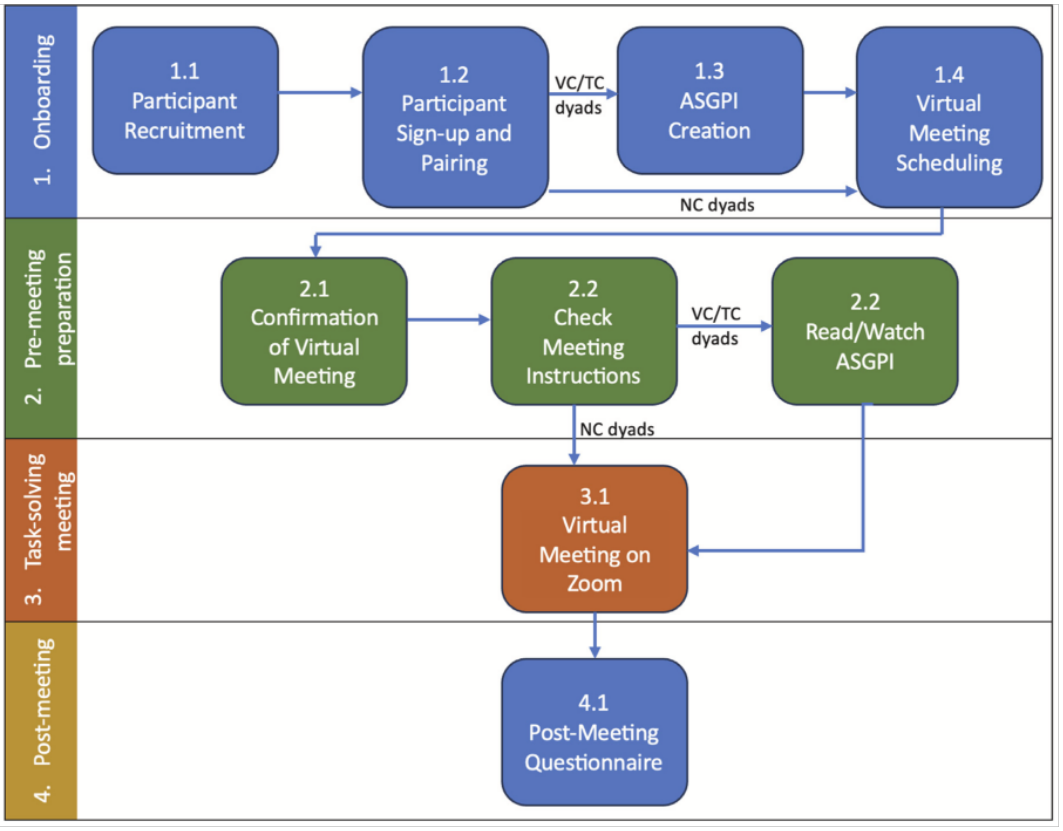

FIGURE 3.2: Four stages of the experiment and outline of steps, 1. the process of onboarding; 2. pre-meeting preparation through scheduling and self-disclosure record; 3. zoom meeting; 4. post-experiment survey.

3.6 Results

This section presents the results of the experimental procedures in four stages: introduction structures, cognitive task performance, perceived team effectiveness, and qualitative insights from interaction logs and post-experiment questionnaires.

3.6.1 Experimental Procedure

The analysis is based on the data collected from 10 NC dyads (20 participants), 9 TC dyads (18 participants), and 9 VC dyads (18 participants). Participants were recruited from multiple global regions - primarily North America, Europe, and Australia. The participants spanned a broad age range, reflecting the multi-generational workforce often found in global virtual teams. The age groups were distributed as follows (Figure 3.3-A): 18–25 (14.29%), 26–35 (30.36%), 36–45 (25.00%), over 45 (30.35%). Gender diversity was also a prominent feature of the sample, with approximately 30.91% of participants identified as female, 47.27% as male, 0% as other, with 21.82% of participants who did not specify their gender (Figure 3.3-B). A breakdown of each of these categories can be observed in Figure 3.3. The sample's distribution included participants from countries such as the United States, India, Romania, the United Kingdom, and Australia (Figure 3.3-C).

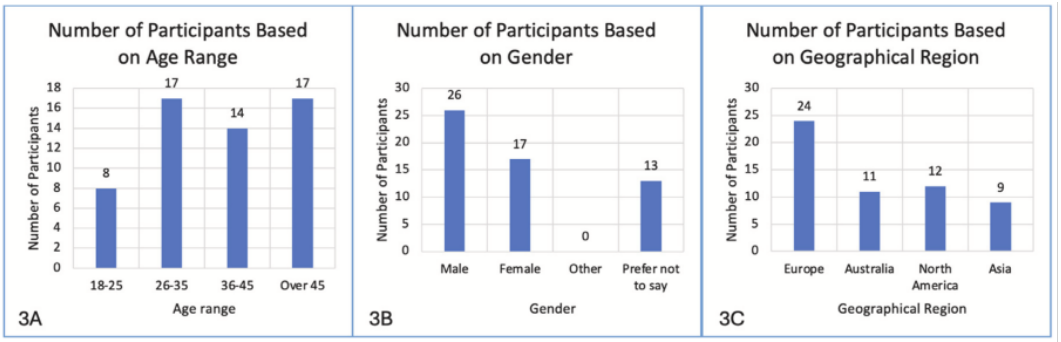

FIGURE 3.3: Distribution of study participants by (3A) Age; (3B) Gender; and (3C) Geographical region.

ASGPI Creation

To gain a deeper understanding of how participants initiated their interactions, the introduction conducted within the three conditions was examined:

1. **Video-based ASGPI:** Introductions averaged 43 seconds per section, combining verbal content with non-verbal cues such as facial expressions and gestures. The average word count was 92 words per section across five structured prompts.

2. **Text-based ASGPI:** Introductions averaged 71 words per section. Participants often incorporated personal anecdotes and outlined professional achievements within the same prompt structure.

3. **No ASGPI:** Participants in this group did not receive any structured introduction format. Three dyads attempted basic introductions by name only, while the remainder shared no information prior to the meeting.

Cognitive Performance

An analysis of task performance was conducted, whilst considering both completion time and accuracy across the three experimental conditions. It is important to highlight that task performance was not uniform, and it was influenced by various factors, such as participants' backgrounds, skills, and individual knowledge, though these were not formally controlled in the study. As one participant remarked, *"I could definitely see that my math abilities were, let us say, not at their best"*, illustrating the role of individual attributes in task execution.

Completion time was determined by totalling the seconds spent on the six tasks, with a maximum possible time of 6×4 min, while accuracy was measured as the number of tasks answered correctly out of six. To evaluate the normality of the data distribution for completion time and accuracy, a Shapiro–Wilk test was conducted. The results, showed in Table 3.2, indicated that none of the three conditions exhibited statistical significance ($p > 0.05$) for either completion time or accuracy, suggesting that the data followed a normal distribution. Therefore, parametric tests were considered appropriate for further analysis.

TABLE 3.2: Descriptive Statistics for cognitive task completion time (in seconds) and accuracy, along with the Shapiro-Wilk statistical test of normality.

Dependent Variable	Descriptive Stats				Shapiro-Wilk Normality Test	
	Condition	Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.
Completion Time	NC	196.944	44.841	12.944	.984	.995
	TC	195.037	45.365	15.121	.947	.662
	VC	190.950	32.152	10.167	.920	.361
Accuracy	NC	4.500	1.167	.337	.900	.156
	TC	3.888	1.536	.512	.924	.429
	VC	3.800	1.686	.533	.910	.283

Given the normal distribution of data in all conditions for both completion time and accuracy, independent samples t-tests were conducted to investigate potential differences in task performance amongst the three conditions. The results of this test are summarised in Table 3.3. The results revealed no statistically significant differences between the conditions regarding completion time or accuracy. The lack of statistical significance indicates that the intervention (ASGPI) along with the formats that were evaluated did not have a substantial impact on task performance. Variations in completion time and accuracy are more likely attributed to individual skills, knowledge, and backgrounds rather than the introduction format.

TABLE 3.3: Independent samples t-test results for cognitive performance (Completion Time and Accuracy) with equal variances assumed (non-significant Levene's Test, $p > 0.05$)

Dependent Variable	Condition Pairing		Levene's Test for Equality of Variances		t-test		
			F	Sig.	t-value	Sig.	Std. Error Diff.
Completion Time	NC	TC	.002	.964	.096	.925	19.870
		VC	.396	.536	.353	.728	16.971
	TC	VC	.295	.594	.228	.822	17.888
Accuracy	NC	TC	.979	.335	1.038	.312	.588
		VC	1.019	.325	1.147	.265	.610
	TC	VC	.012	.916	.120	.906	.743

3.6.2 Perceived Team Effectiveness: TDS Results

To assess the normality of the data distribution for the Team Effectiveness Criteria TDS score, the Shapiro–Wilk test was applied as shown in Table 3.4. Notably, this test revealed that the TDS scores for all three conditions exhibited no statistical significance ($p > 0.05$), indicating that the data conformed to a normal distribution. Given the normal distribution of data across all three conditions, a one-way ANOVA was employed to examine whether there existed a statistically significant difference amongst the three conditions - VC, TC, and NC as presented in Table 3.5. This analysis established whether statistically significant differences existed in perceived team effectiveness between the three conditions. The choice of one-way ANOVA was motivated by the objective to comprehensively assess the impact of these conditions on team effectiveness. Following this analysis, post-hoc multiple comparisons were conducted using Tukey's Honest Significant Difference (HSD) test. This approach enabled a deeper examination of the specific pairwise differences amongst the intervention conditions, llowing identification of which conditions had a statistically significant positive impact on perceived team effectiveness. By following this sequential analytical process, this analysis aimed to provide a robust evaluation of the effectiveness of the interventions and identify any differences between the groups.

TABLE 3.4: TDS results: Descriptive statistics for perceived team effectiveness, along with the Shapiro–Wilk statistical test of normality.

Condition	Descriptive Stats					Shapiro-Wilk	
	N	Mean	Std. Dev.	Std. Err.	Variance	Statistic	Sig.
NC	20	2.608	.595	.133	.354	.976	.871
TC	18	2.732	.383	.093	.147	.981	.965
VC	18	3.224	.532	.125	.283	.916	.109

TABLE 3.5: TDS results: One-way ANOVA to compare effects interventions (VC, TC, and NC) on TDS' subdimension score - Teams' perceived effectiveness.

	Sum of Squares	Mean Square	F	Sig.
Between Groups	3.932	1.966	7.355	.002
Within Groups	13.899	.267		
Total	17.831			

As shown in Table 3.5, the one-way ANOVA revealed that there was a statistically significant difference in the mean of the dyadic team scores ($F(2, 52) = 6.746$, $p = 0.02$ ($p < 0.05$)) between the VC (Mean = 3.224; Std. Dev. = 0.532), TC (Mean = 2.732; Std. Dev. = 0.383), and NC (Mean = 2.608; Std. Dev. = 0.595). Therefore, in light of the significant differences established by the one-way ANOVA, the exploratory analysis continues, including Tukey's HSD post-hoc comparisons shown in Table 3.6, to delve deeper into the results. Post-hoc comparisons were conducted between the conditions to explore their respective effect sizes, providing a more comprehensive understanding of the interrelationships among them.

TABLE 3.6: Tukey's HSD post-hoc multiple comparisons over conditions for perceived team effectiveness (TDS Subdimension score)
*The mean difference is significant at the 0.05 level.

Dependent Variable	I	J	Mean Difference (I-J)	Std. Error	Sig.
Perceived Team Effectiveness	NC	TC	-.123	.170	.750
		VC	-.616*	.167	.002
	TC	NC	.123	.170	.750
		VC	-.492*	.174	.018
	VC	NC	.616*	.167	.002
		TC	.492*	.174	.018

Q1: How does having a text-based ASGPI prior to the team's first meeting affect perceived team effectiveness compared to no ASGPI?

In comparing no ASGPIs with text-based ASGPIs, Turkey's HSD analysis was used to examine the potential effect on perceived team effectiveness. The analysis did not reveal any significant difference between the two methods (Mean = -1.123, Std. Dev. = 0.17); $p = 0.75$, $p > 0.05$. While there was a trend suggesting an improvement in perceived team effectiveness with text-based ASGPIs, the difference was not statistically significant. Therefore, there is a need to explore the next set of questions to address the media type and examine the potential significance of this trend. It is important to note that the lack of statistical significance does not necessarily indicate that the observed trend is not meaningful, but it suggests that the difference between the two methods is not large enough to be detected with the current sample size and statistical methods

used. Further investigation is needed to determine whether the trend is a true effect or merely a chance occurrence.

Q2: How does having a video-based ASGPI prior to the team's first meeting affect perceived team effectiveness compared to no ASGPI?

The results of post-hoc comparisons using Tukey's HSD analysis suggest that video-based ASGPI's are more effective in improving perceived team effectiveness compared to no ASGPI. The data indicates that there is a significant difference in perceived team effectiveness between the two conditions (Mean = 0.616, Std. Dev. = 0.167) with a p-value of p = 0.002, $p < 0.05$.

Q3: How does the effectiveness of a video-based ASGPI prior to the team's first meeting compare to that of a text-based ASGPI?

The post-hoc comparison between text-based and video-based introductions yielded a significant difference in perceived team effectiveness ($p < 0.05$), with video-based ASGPI's showing better results (Mean = 0.492, Std. Dev. = 0.17485) with p = 0.018, $p < 0.05$.

3.6.3 Analysis of Dyadic Interactions Across Experimental Conditions

Qualitative responses were analysed using RTA, treating meaning as co-constructed through participant accounts and researcher interpretation. The qualitative analysis was not intended to reconstruct task interaction turn-by-turn, but to interpret how participants oriented to the task and to one another, and how pre-meeting information shaped perceived engagement during task performance. This section examines patterns of task engagement and interactional orientation during task performance across the three experimental conditions, TC, VC, and NC. To provide a descriptive behavioural indicator of task engagement, two observable interaction types were identified:

- **Explicit Suggestions:** Instances where participants explicitly suggested solutions or approaches.
- **Clarifying Questions:** Instances where participants sought clarification or additional information.

Figure 3.4 illustrates the total number of interactions observed between participants during the task performance in each dyad for all three conditions. These counts are reported as descriptive indicators of interaction opportunity rather than as a qualitative analysis of interaction structure.

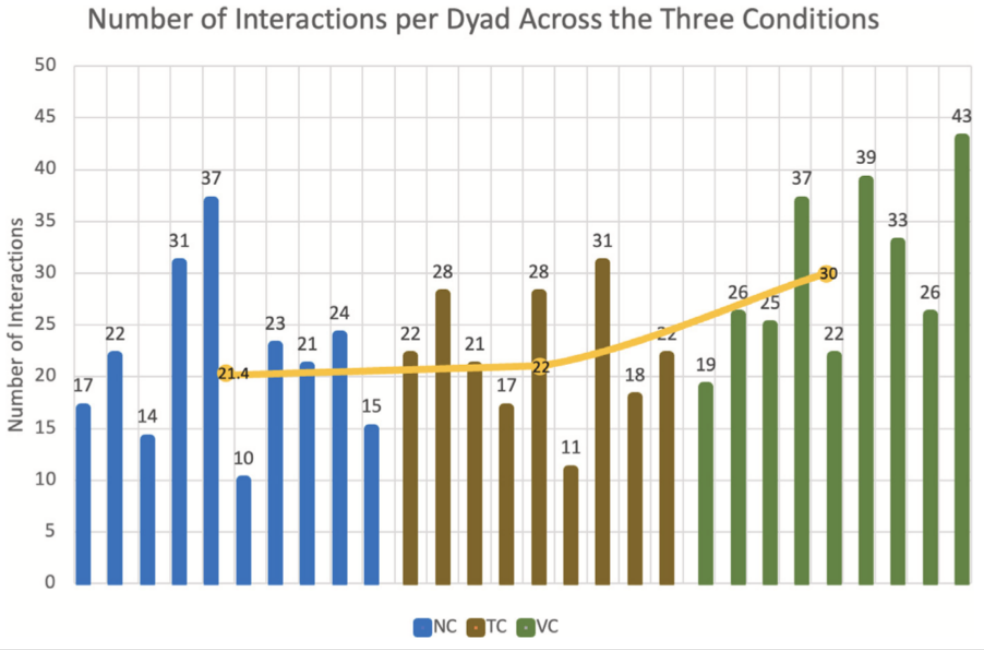

FIGURE 3.4: The total number of interactions (the summary of articulated suggestions and questions) across the dyads of each experiment condition: NC, TV, and VC. Illustrated by the yellow trendline is the average of the interactions in each condition.

To interpret how participants oriented to the task and to each other under different introductory conditions, RTA was employed, guided by Braun and Clarke' framework (Braun and Clarke, 2019; Clarke and Braun, 2017). This approach enabled the identification and interpretation of themes related to task engagement and interpersonal dynamics. Initial coding was driven by both the content of interactions and the underlying context provided by different introductory formats. In the NC groups, where dyads lacked prior knowledge about each other, the analysis revealed a thematic emphasis on task-oriented communication. For example, 8 of the dyadic interactions frequently revolved around clarifications, such as *"How do you think we should do this?"* or *"How do we start?"*, highlighting a straightforward, objective-focused dialogue. This emphasis on direct queries reflected a limited scope of engagement in the absence of prior personal context. Conversely, the TC groups showed a shift in thematic content, with 3 dyads exhibiting an enhanced engagement level. This was reflected in more detailed exchanges that incorporated participants' professional backgrounds, as in *"You work in engineering, did you do anything similar before?"*. This theme of leveraging professional backgrounds for task-related discussions indicated a deeper, though still primarily task-focused level of interaction. The most complex thematic transformation was observed in the video-based ASGPI groups, where the rich auditory and visual cues facilitated a broader range of interactions. Notably, 7 participants moved beyond task clarification, engaging in personal and collaborative discussions. These interactions frequently referenced video content directly, such as articulated suggestions rooted in personal insights from video introductions, such as *"I noticed in your video you said you*

worked with [project details]; could we use that here?". The emergence of this theme illustrates the significant impact of richer introductory formats on fostering collaborative dynamics. From a theoretical perspective, this pattern reflects accelerated Common Ground formation, where shared knowledge established before the meeting is actively mobilised during task interaction, reducing early uncertainty and supporting trust at meeting onset. Because this information exchange occurred asynchronously and under participants' control, it also reduced interpersonal risk at meeting onset, supporting psychological safety by allowing self-disclosure without immediate social evaluation. Furthermore, this is a pattern consistent with Media Synchronicity Theory's account of modality-dependent preparation, without that theory directly justifying the intervention design.

Reflexivity was pivotal in the analytical process, guiding the interpretation of the data and ensuring awareness of the potential influence of the research setting on theme identification and analysis. Adhering to Braun and Clarke' methodological guidelines, this approach enabled a detailed examination of how various introduction methods influence dyadic collaboration, underscoring the significant role of personal and professional backgrounds in enriching team dynamics.

3.6.4 Themes: Analysis of Participant Feedback and Insights on Collaboration

Consistent with the thesis stance, these themes capture how participants interpreted collaboration, rather than providing an interaction-analytic account of task execution. After completing the TDS, participants were asked to provide feedback on their experience and assess the quality of their team collaboration and interaction with their partners through an open-ended question. The qualitative data collected was used to complement the quantitative information and identify any patterns in the participants' experiences. The qualitative input of 45 participants out of the total number of participants was analysed. In this section, an in-depth exploration of the rich insights derived from participants' open-ended responses to the questionnaire are presented. Two researchers reviewed the open-ended responses and developed themes through an iterative coding and refinement process, with reflexive discussion used to challenge interpretations and improve analytic coherence that emerged from participants' comments across the three conditions: (1) relations between cognitive performance and perceived effectiveness; (2) the importance of ASGPI over no ASGPI; and (3) the value of video over text-based ASGPIs.

Theme 1: Divergence Between Perceived Effectiveness and Task Accuracy

This study's goal was to provide participants with a mix of activities that required both logical and intuitive skills, such as drawing, spelling, and calculating. However, it was

found that familiarity with tasks played a larger role in team performance than initially thought. Participants unfamiliar with the specific tasks presented in the study tended to have lower accuracy rates, suggesting that task familiarity may vary significantly across different cultural or educational backgrounds. However, this did not necessarily affect their perception of team effectiveness. Two out of the 18 participants in the TC group mentioned that knowing who the other person was beforehand reduced their anxiety when starting the meeting, even though their team scored lower on accuracy (16%). Similarly, in the VC group, one participant said that they enjoyed the experience despite their poor performance on the tasks because they specialised in geography, while three others mentioned that while they were not great at *"puzzle"* activities, they had *"fun"*. Overall, 24 participants (8 from TC and 15 from VC and 1 from NC) reported that they were more inclined to collaborate, communicate, and solve problems together as a team when they had a professional context about each other before the meeting, whilst only one of the participants from the NC group reported this. Overall, it was discovered that a majority of participants in ASGPI groups expressed satisfaction and enjoyment towards the collaboration experience, with many reporting positive feelings of working together on the tasks, though they acknowledged cognitive performance was not their asset. For example, some participants commented that it was a *"very interesting, exciting experience"* (VC), or that they *"loved working with someone [they had] never met before"* (TC), or that it was *"exciting and fun"* (VC).

Theme 2: Text-based and Video-based ASGPIs: Better than no ASGPI

Amongst the 20 participants in the NC group, a majority of 14 participants opted for succinct and concise responses, averaging around 13 words per section to convey their experiences and thoughts, whilst the remaining 6 participants chose to provide more detailed explanations, with an average response length of 27 words per section. Contrasting the NC group, it is noteworthy that participants in the TC and VC groups displayed remarkable engagement and participation, with all participants in these groups (except for two individuals in the TC group) contributing substantial feedback and in-depth information, forming a significant portion of the qualitative analysis (average response lengths of 33 for TC and 31 for VC). This engagement underscores the effectiveness of text and video-based ASGPIs in fostering deeper involvement and offering more insightful feedback from participants, compared to no ASGPI. However, no difference in responsiveness between TC and VC participants was observed. The difference between these two conditions was more related to the media used, with video-based introductions being more effective in conveying visual cues. Participants in the TC and VC groups wrote more conclusive and elaborated responses, with comments such as *"their experiences and expertise made me curious about them"* (TC) and *"It was very helpful having to see the video of the other group member. It gave me a background to [their] work and [their] personality"* (VC). Three participants in the TC condition expressed a desire to *"say hi"* to the other person and *"see what they're about"*, and two participants

even mentioned finding it tiring to read lengthy written introductions and preferring to get to know their teammates in a different way. These similarities in participant comments were found indicating trends related to the use of professional introductions. Six NC participants stated they felt like something was *"missing"* and expressed a lack of motivation to collaborate. One of these participants described teamwork as something they *"had to deal with"* rather than an *"interesting experience"*, which is what one TC participant pointed out. When comparing NC groups to TC and VC participants, who were professionally acquainted, the more comprehensive feedback and comments point to higher satisfaction on capabilities and team interaction. One TC participant said *"The experience was lovely, I actually learned quite a lot from the other participant, and I'm very happy I decided to join"*. A VC participant stated *"Really loved it, wish there were more tasks so that we could have a bit more fun solving them. It all came so natural to both of us!"*.

Theme 3: Text Versus Video ASGPI: Impact on Interactional Balance

In the analysis of participants with video-based ASGPI and text-based ASGPIs, the information provided in the Professional Familiarity Questionnaire was compared with the comments made by participants in TC or VC groups. In TC groups, while 11 out of 18 participants gave extensive professional information in their ASGPIs (more than three-quarters, 75 words, of the available space), the other 7 gave only brief statements and used less than half (50 words) of the available writing space per section. One TC participant mentioned that their partner *"wrote a lot at the beginning"*, and another felt *"a bit bad"* about not providing as much information as their partner. No such comments were observed from the VC participants, as VC groups had a more balanced amount of information from both team members due to the use of recordings: all 9 VC dyads had made use of the 1-min limits on videos. This aspect emphasises the importance of balance in the information provided by both participants in self-disclosure, which can lead to quicker trust formation. In VC dyads, communication was more balanced, with participants of 6 dyads frequently expressing appreciation for their partner's input and agreeing on task management and problem-solving strategies, as evidenced by statements such as *"I'll read a question, and you read the next one"* and *"You solve the first half of the question, and I'll solve the second half"*. This interaction only occurred 3 times in TC groups, and none in NC groups. This is reported as an observational pattern rather than a sequential analysis. Moreover, it was found that VC participants engaged in humour and collaborative problem analysis more frequently than participants in the TC groups. Specifically, in the VC condition, 7 of the dyads made jokes or collaboratively analysed the tasks, indicating a quicker development of interpersonal interaction, compared to only 3 dyads in the TC group.

Furthermore, the differences between the TC and the VC groups become more apparent from further observations made by participants in regard to their information sharing. Participants in TC groups felt as though *"something was missing"*. For example, one

participant stated they *"had little time to know more about each other outside of the tasks"*. Thus, seeing and hearing one's professional expertise and experience adds value that is harder to extract from text alone. One of the VC participants noted that *"seeing who I'm gonna talk with definitely helped me accommodate with the process easier and faster"*. Such observations were supported by NC participants as well, where one declared that *"it may have been helpful to have a couple of minutes to see them and say hi"*. Furthermore, the uneven balance between TC dyad introductions imposed a feeling of uncomfortableness, as it was discovered that in one dyad, a participant stated *"I felt a bit guilty because [their partner] has written more than me in their introduction"*, whilst a participant in another dyad saying *"I didn't know if the information I'm providing is much more detailed than [their partner]"*. However, VC dyads did not face this challenge, as it was clear how long people had for their responses. On the contrary, participants within the VC groups expressed satisfaction with the opportunity of viewing their partner's introduction video prior to the first meeting, with one participant stating that they *"watched [their partner]'s video twice"* and another mentioning that *"the fact that I knew the other person before joining the meeting made me feel less anxious about what I need to do"*.

3.7 Discussion

This study evaluated the effect of asynchronous professional introductions on perceived team effectiveness in unfamiliar virtual dyads. In the following section, the results of the study will first be discussed and then an examination of its limitations will be conducted.

3.7.1 Impact of Asynchronous, Semi-Guided, Professional Introductions

Previous research has shown that effective team introductions can improve communication and collaboration within the team (Owens and Hite, 2022; Sutherland et al., 2022). HCI research, in particular, has primarily focused on improving the virtual meeting time and environment for remote teams through the use of data visualisations and virtual environment representations (Altschuller and Benbunan-Fich, 2013; Jones et al., 2020; Son et al., 2019). This focus has addressed the in-meeting dynamics. However, the study highlights the importance of exploring ways to support team collaboration outside of the meeting itself in what is refered to here as the "meta-meeting" space. Building on previous research on virtual team collaboration and icebreaker activities, this work examined the impact of different types of introductions in an online group work setting, which is becoming increasingly common in the current era of remote work and online learning. In this study, the ASGPI tool was used to explore this meta-meeting space, and the findings suggest that there may be further opportunities to develop and utilise this time and space. Statistical tests were employed to compare the impact of no

ASGPI, text-based ASGPIs, and video-based ASGPIs on perceived team effectiveness and collaboration.

Leveraging the Meta-Meeting Space

The quantitative analysis revealed clear differences in the impact of introduction formats on perceived team effectiveness. Video-based ASGPIs significantly outperformed both text-based and no introductions, while text-based ASGPIs showed a positive, although non-significant, trend compared to no introduction. These findings underscore the effectiveness of video-based introductions in fostering early collaboration. Recent research further supports this, suggesting that visual cues reduce misinterpretation and promote more favourable first impressions (Yang et al., 2023). In this study, video introductions enabled participants to convey authenticity, emotional tone, and professional identity more effectively than text-based alternatives. Within the governing stance of this thesis, the benefit of video-based ASGPIs is interpreted not as increased media richness per se, but as enhanced Common Ground formation achieved under psychologically safe, low-pressure conditions prior to live interaction, with media properties treated as enabling conditions rather than explanatory mechanisms. The higher symbol variety and immediacy of feedback in video introductions likely facilitated early convergence between participants.

Video-based ASGPIs allow for personalisation, self-expression, and social bonding, which are crucial for enhancing team effectiveness and collaboration (Johnson et al., 2014). Videos excel in conveying non-verbal information that can be lost in text-based ASGPIs, deepening the understanding of team members' personalities and communication styles (Yang et al., 2023). This enables team members to gain a deeper understanding of their colleagues' personalities, tones, and communication styles, leading to enhanced trust and collaboration. In addition, video-based introductions provide a level of flexibility that is not possible with text introductions, making them particularly valuable for remote dyads or dyads operating across different time zones. These findings underscore the importance of considering the media type in introductions and suggest the potential benefits of video-based ASGPIs for fostering community, collaboration, and creativity amongst team members. However, the use of video in introductions can also accentuate surface-level differences amongst culturally diverse team members, potentially fostering a sense of "otherness". While video-based ASGPIs excel in conveying non-verbal cues and facilitating deeper understanding and social bonding, they may also highlight differences in skin colour, attire, and accents, impacting perceptions, trust levels and team dynamics (Little and Roberts, 2012; Birkás et al., 2014).

Moreover, the study indicates that supporting collaboration in the meta-meeting time and space plays a pivotal role in enhancing not only performance and trust but also in fostering team closeness and the feeling of connectedness amongst team members.

The positive impact of ASGPI formats, particularly video-based introductions, on perceived team effectiveness extends beyond the quantitative measures that were examined. It encompasses the qualities that contribute to team cohesion and synergy. The ability of video-based ASGPIs to convey authenticity, emotions, and personalisation is a demonstration of their potential to strengthen interpersonal connections. These qualities provide an opportunity for team members to not only understand each other's professional backgrounds but also to connect on a more personal level. By offering a richer and more engaging experience, video-based ASGPIs create a sense of community, enabling team members to establish not only professional but also personal bonds. This capability is particularly valuable for remote dyads operating across different time zones, where synchronous bonding is limited, as it transcends geographical boundaries and bridges the gap between team members scattered across different time zones. As organisations increasingly rely on remote and virtual teams, the nurturing of such connections outside of formal meetings is a strategic avenue for fostering effective teamwork in virtual environments. However, acknowledging the dual nature of video introductions, future applications should consider strategies to mitigate the potential for emphasising "surface-level diversity", such as cultural sensitivity training and guidelines for creating inclusive video content. Moving forward, the findings indicate promising avenues for using video-based ASGPIs to enhance perceived team effectiveness, although these results are context-specific. Further research is imperative to understand how these methods can be generalised across various virtual team settings. Given the dual nature of video introductions, future studies should explore strategies to harness their potential for deepening interpersonal connections while also addressing the challenges they present in highlighting cultural and personal differences.

Key Aspects to an ASGPI: Asynchrony, Semi-Guidance, Professional Familiarity

This study provides further insights into the roles of asynchrony, semi-guidance, and professional familiarity in dyadic team collaboration and the formation of ASGPIs. The benefits of asynchrony became evident as participants had the opportunity to get to know each other before the meeting, facilitated by the ASGPI tool, which allowed them to view each other's video introductions in advance.

The semi-guidance aspect, especially evident in the professional context of introductions, proved to be influential in shaping the dyad's collaborative dynamics. The structured nature of these introductions provided team members with a well-defined framework to follow, encouraging them to introduce themselves with a professional focus. This semi-guided approach not only streamlined the introduction process but also ensured that team members highlighted their professional expertise, experiences, and competencies, making it easier for others to grasp the value each individual brought to the team.

Lastly, the professional familiarity aspect was found to be crucial for effective collaboration, as evidenced by participants' comments in both the TC and VC groups. Team members expressed their desire to collaborate again or stay in touch, emphasising the importance of professional connections. The study's TDS results further confirmed the significance of professional knowledge amongst team members: both TC and VC participants provided more comprehensive responses, demonstrating their curiosity about their team members and the value of understanding their professional backgrounds and personalities.

In contrast to using ASGPI formats, participants' qualitative responses showed that NC participants expressed lower motivation to collaborate and viewed teamwork as a task they simply *"had to deal with"*. Conversely, those in TC and VC groups exhibited higher satisfaction, acknowledging their colleagues' capabilities and the overall team interaction. The findings collectively emphasise that by dissecting these aspects of asynchrony, semi-guidance, and professional familiarity, the study contributes valuable insights into optimising team collaboration in virtual environments.

Cognitive Performance, Interactions and ASGPI

While significant effects of ASGPI formats were found on perceived team effectiveness and collaboration, cognitive task performance was not significantly influenced by the introduction format. This suggests a decoupling between social collaboration outcomes and individual cognitive performance. Although ASGPIs enhanced interpersonal engagement and trust formation, cognitive performance remained shaped by participants' individual attributes, such as prior knowledge, skills, and problem-solving abilities. From a Common Ground Theory perspective, this suggests that ASGPIs primarily support shared understanding and interactional readiness rather than individual problem-solving capacity. This distinction is consistent with accounts of cognitive task performance that differentiate intrinsic task demands from social and interactional conditions (van Bruggen et al., 2002). While ASGPI formats reduced social uncertainty and improved interpersonal dynamics, they did not reduce the intrinsic cognitive load required to complete the tasks. This finding reinforces the complex nature of virtual teamwork, in which social effectiveness and cognitive performance may operate independently. As remote collaboration becomes more prevalent, it is crucial to recognise that interventions designed to support team engagement may not automatically translate into improved task accuracy. Interventions such as ASGPIs can improve the social dimension of virtual teamwork without necessarily affecting individual cognitive capacity. This outcome is consistent with the design intent of ASGPIs, which are not intended to optimise task accuracy, but to stabilise early interactional conditions under unfamiliarity. However, Carte and Chidambaram (2004) argue that strategic deployment of collaborative technology capabilities may enhance both engagement and performance by better managing team diversity. This points to the need for future approaches that address cognitive and interpersonal dynamics as distinct but interrelated

dimensions of virtual collaboration. This dissociation is consistent with the triangular state framework, in which improvements in trust and satisfaction do not necessarily imply immediate gains in task performance, particularly during early-stage collaboration.

In addition to cognitive performance, participant interactions during the experiment were examined through the three conditions and observed patterns of collaborative dynamics fostered by different introduction formats. The difference in the average number of interactions across conditions suggests that a richer introduction format, a video-based ASGPI, stimulates a more engaged and interactive environment amongst participants. The thematic analysis further unravelled the nature of these interactions. In NC groups, interactions were predominantly task-centric, with participants seeking basic clarifications. TC groups exhibited a deeper engagement, with participants leveraging textual information for discussions. VC groups, benefiting from both visual and auditory cues, surpassed the others. Here, interactions transcended task-related queries to include personalised exchanges and collaborative problem-solving. This aligns with prior research emphasising the impact of media richness on collaborative outcomes (Olson and Olson, 2013). This exploration underscores the role of introduction formats in shaping the collaborative dynamics within dyadic teams, with richer media fostering a more interactive and engaged environment.

Implications over Subsequent Uses of ASGPI

In this study, the advantages of supporting team collaborations in the pre-meeting asynchronous space are investigated, beyond the virtual meeting, which leads to a more efficient and effective collaboration process. To achieve an equal-playing field, this study proposes a standardised format for creating virtual professional introductions that allow everyone to be heard before the actual meeting. The asynchronous approach enables individuals to make unlimited edits and take their time in creating their introductions, leading to introductions that are not challenged during subsequent meetings, thus promoting trust formation.

A significant benefit of this approach is the time-saving factor. Once these introductions are recorded, they can be reused for multiple instances, eliminating the need to repeat the process in every meeting. This contrasts with the traditional synchronous method where valuable meeting time is dedicated to individual introductions and listening to others' introductions, often taking up a substantial portion of the meeting's duration. In a hypothetical scenario, when individuals first adopt ASGPI, they invest time in creating and editing their initial introductions. Before the initial team meeting, each team member is required to view the introductions of others. However, as they engage in subsequent collaborations with new teams, the efficiency of using pre-existing video introductions becomes evident. New team members can simply view their colleagues' introductions without the need to create their own, resulting in significant time savings.

By reusing these introductions, valuable time is saved, illustrating the efficiency of this study's approach.

In this study, thoughtful responses to the questions within the Professional Familiarity Questionnaire were integral to this research' approach in enhancing perceived team effectiveness. While some of the questions may require more in-depth thinking, they were designed to encourage participants to share essential professional information, thereby fostering a deeper understanding of their team members. The video creation process, accompanied by clear examples and time constraints, was carefully structured to strike a balance between eliciting meaningful responses and maintaining efficiency. It is worth noting that while the initial time investment for participants to create their video introductions may seem substantial, the ability to reuse these introductions for subsequent collaborations introduces significant efficiency gains. This mechanism reduces the time spent on repetitive introductions, enabling team members to redirect their efforts towards more productive discussions and collaborative work.

In essence, this research proposes a shift from introducing oneself in the synchronous to the asynchronous, highlighting the advantages of pre-meeting preparation. By watching these introductions beforehand, team members can arrive at the meeting already acquainted with their colleagues, leading to a more focused, time-effective, and productive meeting. This approach not only saves time but also enhances the overall meeting experience, allowing team members to engage more deeply in discussions and decision-making rather than spending valuable meeting time on repetitive introductions. Moreover, this approach becomes even more advantageous in larger team settings, particularly due to the semi-guidance factor, which provides a controlled introduction process and ensures that all team members present balanced responses in terms of both time and content - a critical consideration for maintaining effectiveness in larger collaborative environments.

3.7.2 Limitations

Larger Team Settings

This study focused exclusively on dyadic virtual teams, and the findings may not generalise to larger group contexts. Although the results offer insights into dyadic collaboration, larger groups introduce additional coordination, communication, and role distribution challenges that were not examined. Teams comprising more than two members often exhibit intricate dynamics, which can be further influenced by factors such as coordination, communication, and workload distribution. The potential impact of ASGPI on larger teams is an area that warrants exploration in future research, as the dynamic interplay within larger teams may yield diverse outcomes. As such, the study

serves as a foundational step in understanding ASGPI's implications for team effectiveness within dyadic collaborations, with opportunities for extending this knowledge to encompass larger team scenarios.

Professional Familiarity Content

The limitation regarding the Professional Familiarity Questionnaire pertains to the nature of the content generated by participants in response to items within the Professional Familiarity Questionnaire. The Professional Familiarity Questionnaire encouraged participants to share professional strengths and achievements. However, this emphasis may have introduced a positivity bias, limiting the diversity of experiences disclosed. This limitation primarily relates to the potential for self-disclosure to be skewed towards positive narratives, possibly diminishing the depth of shared experiences amongst team members. By fostering an environment where participants can express both positive and negative aspects, a more comprehensive understanding of professional familiarity could be obtained, offering insights into the intricacies of team dynamics. Future research may consider incorporating this approach to further explore the multifaceted nature of professional familiarity and its influence on collaborative outcomes. Furthermore, future iterations should consider allowing disclosure of challenges or failures, which may foster deeper relational trust and authenticity.

Cross-Cultural Global Teams

The sample predominantly reflected Western norms and practices in professional introductions, potentially limiting cross-cultural applicability. The impact of cultural differences in multicultural teams is apparent (Laroche, 2012), and the research framework, predominantly drawn from Western sources, may not fully capture the diverse practices and cultural variations associated with professional introductions globally. Stahl et al.' meta-analysis 2010 and research by Hertel et al. (2005) underline the critical importance of understanding cultural diversity's impact on team processes, especially in the context of global virtual teams. Additionally, Staples and Zhao (2006) and He et al. (2017) work suggest that technological interventions can mitigate some challenges posed by cultural diversity, pointing towards the potential for more inclusive collaboration tools. However, the study's underrepresentation of non-Western introduction practices highlights a gap. The recognition of cross-cultural distinctions in professional introductions is crucial. Professional practices, particularly introductions, can significantly differ across cultures, sometimes emphasising relational aspects over task-related details (Laroche, 2012). The findings suggest that effective communication and trust-building, crucial from the onset of team formation, must be sensitive to these cultural differences. Conducting the study in English may have affected contributions from non-native speakers, particularly in text-based ASGPIs, where writing fluency

plays a greater role, as evidenced by He et al.' emphasis on automated feedback fostering empathy amongst team members from diverse backgrounds. To bridge the effectiveness gap identified in virtual dyadic teams and beyond, future studies should delve deeper into the practices and cultural variations associated with professional introductions in a global context. Exploring the specific mechanisms through which cultural diversity influences team dynamics and outcomes, as suggested by the work of Staples and Zhao (2006), and examining the role of technology in enhancing cross-cultural understanding, will be critical. While this work acknowledges the role of technology in potentially bridging cultural gaps (He et al., 2017), it is advised to keep caution in extending the results to non-Western settings without further research that includes a broader range of cultural perspectives. This approach will not only address the limitations highlighted by this study but also pave the way for developing more culturally inclusive virtual work environments.

These insights directly inform the next chapter, which explores real-time engagement interventions in synchronous, familiar dyads.

3.7.3 Future Work Considerations

The findings open several directions for future investigation in meta-meeting design and asynchronous collaboration tools. Longitudinal studies could examine how ASGPIs influence sustained collaboration, evolving team trust, and performance across multiple meetings or project stages. Another promising avenue for future research is exploring the impact of incorporating bodily knowledge (Guo et al., 2023) such as chronotypes and chronobiology into virtual team collaboration design. Jun et al.'s research (2019) provides a starting point for this exploration, demonstrating that bodily knowledge can enhance trust-building experiences in team collaboration. However, there is a gap in the literature regarding the application of this concept in virtual teams, and further research is needed to understand its potential benefits. Incorporating bodily knowledge into virtual team collaboration design presents an exciting opportunity for future research in enhancing trust-building experiences and fostering effective collaboration (Andres et al., 2020; Jun et al., 2019; Tabor et al., 2020). These insights also directly inform the next chapter (Chapter 4), where synchronous interventions are explored for supporting conversational balance in virtual dyads.

3.8 Conclusion

Collaboration and trust are often more difficult to establish in virtual dyads than in face-to-face teams, particularly in unfamiliar settings. Research has previously highlighted the importance of introductions and their impact on team satisfaction, trust,

and engagement. However, in the field of HCI, there has been a lack of exploration into the support of interactions for introductions. This chapter has addressed that gap through the development and evaluation of ASGPI, offering valuable contributions to this under-investigated area.

1. First, the study assessed the effectiveness of ASGPI as a mechanism for Asynchronous, Semi-Guided, Professional Introductions in new virtual dyadic teams. The results showed that the video-based form of the approach positively contributes to perceived team effectiveness, by supporting early trust formation, as evidenced by a higher perceived team effectiveness score compared to the text-based and no ASGPI conditions (see Section 3.6).

2. ASGPI offers a unique innovation by providing introductions outside of the meeting context, allowing for asynchronous access by all team members. The qualitative responses (Section 3.6.4) suggest that this approach is highly valued, as it enables rehearsal and time limits on a set of questions that can enhance the value of the introduction beyond what is possible in synchronous virtual meetings.

3. The Professional Familiarity Questionnaire (Section 3.3.3), which forms the foundation of ASGPI, draws from research on the value of professional competencies that enhance perceived team effectiveness and ultimately, trust and satisfaction with collaborative processes. This questionnaire has the potential to be applied in other contexts beyond ASGPI.

Furthermore, the COVID-19 pandemic has brought to light the issue of back-to-back meetings and the negative impact it can have on productivity and wellbeing (Augstein et al., 2023). As a result, there has been a growing interest in finding ways to create space between meetings and improve the quality of virtual interactions. The research suggests that the use of video-based, asynchronous, semi-guided, professional introductions can help address this issue. By providing team members with the opportunity to get to know each other's professional backgrounds before meetings, it allows for more focused and productive discussions. Moreover, this approach can be especially helpful for dyads working across different time zones, as it provides a way for team members to connect and collaborate asynchronously, reducing the need for constant synchronous communication. While this study's approach provided insight into how introductions affect team interaction and perception, the small sample size limits the ability to make broader generalisations. Future work should therefore examine ASGPI in larger and more culturally diverse settings.

To summarise, ASGPI employs a strategy of Dixian Reconstruction, rather than Reproduction, to translate physical introductions into digital environments. By leveraging the benefits of asynchrony, rehearsal, and semi-guidance, this chapter has proposed

and tested an approach that aims to improve perceived team effectiveness in unfamiliar virtual dyads.

In terms of the triangular state of team dynamics, Chapter 3 demonstrates how trust-oriented, asynchronous interventions can stabilise early perceptions of team effectiveness, setting the conditions for the real-time engagement challenges addressed in the next chapter. These findings provide a foundation for the next stage of this thesis. While the work presented in this chapter focused on unfamiliar teams and asynchronous pre-meeting interactions, Chapter 4 shifts to synchronous collaboration in familiar dyads. There, the focus turns to the real-time monitoring of engagement metrics - such as interruptions, speaking balance, and pauses - through live visual feedback. Taken together, the asynchronous and synchronous interventions presented across Chapters 3 and 4 form a two-part response to the broader research problem introduced in Chapter 1 and framed in the literature review (Chapter 2): how to support more effective, trust-building communication in virtual dyadic teams.

Chapter 4

(Synchronous, Familiar Contexts): ”Let Me Talk!” - Exploring Feedback Mechanisms in Video-Based Dyadic Communication: Introducing Engagement Metrics to Analyse Conversational Dynamics and Improve Collaboration, Satisfaction, and Behavioural Awareness Among Familiar Pairs

4.1 Introduction

This chapter continues the thesis's broader investigation into structured interventions for improving engagement in remote dyadic communication. Within the triangular state framework introduced in Chapter 1, this chapter focuses on the interactional balance and behavioural coordination components of engagement. Unlike Chapter 3, which addressed early trust formation through asynchronous preparation, the present work assumes baseline familiarity and examines how real-time feedback can stabilise conversational dynamics during live interaction. It examines how real-time feedback

systems that visualise quantifiable conversational signals (i.e. speaking balance, interruptions, and pauses) can support turn-taking, reduce interruptions, and improve interaction quality during live video calls. This progression reflects the thesis's overarching aim to explore complementary methods for enhancing communication in remote one-on-one settings.

With the increasing reliance on digital communication, ensuring effective engagement in video-based CMC has become crucial for remote collaboration and social connection. This shift from in-person to video-mediated interaction introduced new challenges in maintaining interaction quality, particularly due to the absence of non-verbal cues that support coordination, such as gaze, gesture, and body orientation (Daft et al., 1987; Kiesler et al., 1984). This part of research focuses specifically on video-based CMC, where such issues are especially pronounced.

In face-to-face settings, turn-taking and conversational balance are shaped by subtle social signals like gaze, posture, and timing (Walther, 1996; Biocca et al., 2003). However, in video communication, these cues are often delayed, distorted, or entirely absent. As a result, speakers struggle to coordinate turns, leading to more interruptions, prolonged silences, and uneven participation (Koudenburg et al., 2017; Wiederhold, 2020). Several HCI studies have proposed compensatory tools, such as gaze awareness indicators (Vertegaal et al., 2001), backchannel detection (Kawahara et al., 2008), or embodied avatars (Bailenson et al., 2006), but these often rely on specialised hardware or constrained lab environments, limiting their scalability. Even when some features like speaking time or pauses are measured, they are typically used for post-hoc analysis (DiMicco et al., 2004) rather than as real-time, user-facing feedback.

Within the governing stance of the triangular state of team dynamics, the engagement-metrics intervention is not justified through MST or cue replication. Instead, it is grounded in cognitive load and self-regulation perspectives, which explain why participants struggle to monitor conversational balance under conditions of degraded or misaligned cues during live video interaction. SIPT is used only contextually to explain why such cue misalignment becomes socially consequential, as participants attempt to infer engagement, dominance, or attentiveness from unreliable signals within a single session. However, because SIPT assumes that relational meaning stabilises over time, it does not prescribe how to support rapid, in-meeting regulation. The intervention therefore targets this cognitive-regulatory constraint directly by externalising conversational dynamics in a manner that minimises additional attentional overhead.

Rather than replicating non-verbal behaviours through avatars or gesture simulation, this approach uses measurable conversational signals to support engagement. The system processes conversational data in real-time and surfaces structured feedback via subtle visualisations, allowing participants to regulate interruptions, balance speaking

time, and reduce excessive pauses. In doing so, it offers a scalable feedback model designed to improve interaction quality without inducing cognitive overload or requiring specialised hardware.

Despite growing interest in video communication tools, a persistent challenge remains: how to deliver engagement feedback that is both informative and non-intrusive. Research has shown that awareness of one's conversational behaviour can improve interaction quality (Bickmore and Cassell, 2001; Gnewuch et al., 2018), yet little is known about the optimal modality and timing for such feedback in real-time. Prior work using real-time visualisations (Kim et al., 2008) has not systematically examined how feedback affects stress, satisfaction, or interaction dynamics in dyadic, task-oriented settings. The feedback system proposed here is designed to enable immediate behavioural awareness while preserving conversational flow and user autonomy.

This research directly addresses that gap through two empirical studies. Study 1 compares synchronous inter-meeting feedback with a synchronous Wizard-of-Oz real-time overlay to test how timing affects user awareness and behaviour. Study 2 builds on these insights to evaluate a synchronous, in-meeting, fully automated feedback system, incorporating live visualisations (i.e. race-track and colour-coded notifications) and examining their impact on interaction quality and communication satisfaction. The system was developed with user input, aiming to refine real-time feedback into a minimally disruptive tool for real-world use.

Overall, this work offers three key contributions: (1) identifying and operationalising engagement metrics as real-time feedback signals in video communication; (2) understanding how awareness of these metrics can influence user behaviour through two empirical studies, including a fully automated system; and (3) providing design insights for real-time feedback that balances awareness, user agency, and comfort. By moving beyond retrospective analytics and hardware-heavy solutions, this research presents a practical, scalable, and user-tested model for supporting effective engagement in video-based dyadic communication.

4.1.1 Research Question

Together, the two studies in this chapter address the following overarching research question:

- **Q:** How can synchronous, inter-meeting and in-meeting, real-time feedback based on engagement metrics improve interaction quality, behavioural awareness, and communication satisfaction through improved interactional balance in dyadic video meetings?

This question reflects the central aim of this chapter: to explore the design and impact of automated, in-meeting feedback systems that support balanced, fluid, and satisfying communication between remote partners. Each study addresses distinct aspects of this goal-timing and behaviour in Study 1; design and usability in Study 2 - while contributing to a shared understanding of engagement awareness in synchronous CMC.

4.2 Related Work

Previous chapters (Chapters 2 and 3) reviewed literature on virtual team collaboration, conversational awkwardness in unfamiliar dyads, and the role of asynchronous introductions in fostering trust and effectiveness. Those reviews focused on macro-level factors such as team familiarity, perceived professional competence, and pre-meeting social grounding. In contrast, the current chapter shifts to micro-level interaction dynamics during live video meetings between familiar dyads. It synthesises work on turn-taking behaviours - specifically speaking balance, pauses, and interruptions - and integrates findings from HCI and psycholinguistics to develop an operational framework for real-time engagement feedback. This shift from asynchronous trust-building to synchronous coordination represents the second major strand of this thesis. This section reviews existing research on social engagement in video-based CMC, with a particular focus on how engagement can be measured and supported through computational feedback. It introduces the three conversational features central to this study - speaking balance, pauses, and interruptions - and examines how these features have been conceptualised and operationalised in prior HCI and CMC research. The section concludes by investigating key limitations in the literature and clarifying how this work addresses them through a novel, real-time feedback approach. Within the broader triangular state of team dynamics outlined in Chapter 2, this chapter addresses the real-time coordination layer of engagement, focusing on how balance, timing, and responsiveness can be supported once social grounding has been established.

4.2.1 Social Engagement in Video-Based CMC

Social engagement in digital settings has been widely studied across CMC and HCI, typically defined as a user's cognitive, emotional, and behavioural investment in an interaction (Riva et al., 2024). In early foundational work, Walther (1996) discussed how media richness and reduced social cues on digital platforms can affect interpersonal outcomes, while Short et al. (1976) and Rice (1993) introduced the concept of social presence - how "together" users feel despite being physically apart. Higher social presence has been linked to improved rapport and conversational fluidity (Gunawardena, 1995; Picciano, 2002).

However, video-based CMC is often marked by degraded or missing non-verbal cues such as eye contact, facial expressions, and gesture synchrony (Biocca et al., 2003; Gudykunst and Nishida, 1994). These limitations disrupt turn-taking and can weaken the sense of mutual attentiveness. The accelerated reliance on video platforms during the COVID-19 pandemic (Nadler, 2020) made these shortcomings more visible, even as platforms offered convenience (Wiederhold, 2020). Bailenson (2021) coined the term Zoom Fatigue previously defined in Chapter 2 to describe the cognitive load associated with decoding sparse social cues, while Fauville et al. (2021) and Raghuram et al. (2019) found that delays and misinterpretations in silence often erode trust, particularly in team settings. In educational and organisational contexts, this translates to lower satisfaction (Subrahmanyam and Greenfield, 2008), increased miscommunication (Walther, 2011), and elevated stress. Collectively, these findings point to a pressing need for digital tools that can help users better interpret or compensate for absent non-verbal signals in real-time.

While Chapter 3 discussed the importance of social presence and rapport at a conceptual level or via asynchronous interventions, this section has highlighted how degraded non-verbal cues during live video calls create specific engagement challenges that call for real-time support - setting the stage for the metrics introduced below.

4.2.2 The Role of Dyadic Structures in This Research

This study builds upon the foundation established in Chapter 2, which highlighted the centrality of dyads in human interaction, and Chapter 3, which explored asynchronous introductions as a tool for establishing familiarity in unfamiliar dyads. In contrast, the current study focuses on familiar dyadic teams. Familiar dyads are particularly valuable for studying subtle behavioural changes in response to feedback. Their pre-existing rapport minimises variability due to trust-building or social uncertainty, allowing for a more direct assessment of how real-time visualisations influence interaction dynamics. Research shows that familiar dyads exhibit more fluid turn-taking, mutual adaptation, and efficient communication compared to unfamiliar ones (Hinds et al., 2000; Barrick et al., 2007). These interactional efficiencies allow behavioural shifts to be more confidently attributed to the intervention itself rather than to interpersonal uncertainty.

Moreover, feedback systems in dyadic settings are less likely to introduce social complexity or hierarchy effects that are typical in triads or larger groups (Moreland and Levine, 2001; Bonner et al., 2002). The absence of a third familiar interlocutor reduces the risk of feedback being misattributed or diluted across speakers. This makes the dyadic setting ideal for observing moment-to-moment awareness changes and behavioural adjustments - particularly important when testing interactive feedback dashboards designed to surface conversational metrics.

Additionally, although prior studies have examined team familiarity in collaborative performance contexts, such as distributed decision-making or leadership emergence (Bonner et al., 2002; Hinds et al., 2000), they often overlook how real-time system feedback may interact with the social baseline established by familiarity. In other words, while the benefits of familiarity for communication outcomes are well known, there remains a gap in understanding how familiar dyads respond to system-level interventions aimed at shaping turn-taking or engagement awareness. This study addresses that gap by situating real-time, visual feedback mechanisms within the context of previously acquainted dyads - enabling a thorough analysis of how familiarity modulates receptiveness to and behavioural integration of feedback cues. Hence, this study's focus on familiar dyads provides a controlled yet valid environment for evaluating the efficacy of inter-meeting and in-meeting feedback mechanisms.

4.2.3 Operationalising Conversational Cues as Engagement Metrics

Building on Chapter 2's discussion of conversational structure and engagement, this section moves from theoretical constructs to practical, speech-based features that can be computed in real-time. Whereas Chapter3 focused on pre-meeting familiarity-building, the current section addresses real-time dynamics that support conversational rhythm and responsiveness.

Non-verbal cues like eye gaze, gesture, and posture are well established as vital for regulating interaction in face-to-face settings (Argyle and Dean, 1965; Kendon, 1990). However, in video-based CMC, these cues are often reduced, distorted, or entirely absent. Rather than attempting to replicate these signals through complex sensor-based systems - such as eye-tracking or pose-estimation technologies (i.e. (Ahuja et al., 2022; Tramontano et al., 2021)) - this research focuses instead on speech-derived conversational features: speaking balance, pauses, and interruptions. These are captured using only standard microphones and software-based algorithms, without the need for specialised hardware.

While not non-verbal in the strict sense, these features convey structure and intent in a similar way - helping coordinate turn-taking, signal attentiveness, or manage conversational rhythm. As such, they are treated in this study as behavioural proxies for engagement: they are observable, measurable, and amenable to real-time automated feedback. Prior studies have examined some of these features individually in domains such as health communication (Bodie and Jones, 2012), classroom interaction (Fredricks et al., 2004), and human-robot dialogue (Yu et al., 2015), but their combined, real-time application in supporting human-to-human video calls remains underexplored. Notably, few systems have provided live visual feedback of such cues to promote self-regulation as interaction unfolds.

The remainder of this subsection defines and contextualises each metric, detailing how it has been used in existing literature and how this approach refines and integrates them into a cohesive, user-facing feedback system.

Speaking Balance

Speaking balance refers to the equitable distribution of speaking time between participants. In collaborative dialogue, balanced turn-taking has been linked to increased perceptions of conversational equity, defined as the sense that participants have an equal opportunity to contribute, as well as inclusion and conversational satisfaction (Bavelas et al., 2000; Bodie et al., 2012). In face-to-face settings, this balance is often maintained through subtle cues such as gaze shifts, posture, and shared social norms. In contrast, video-mediated conversations lack many of these cues, increasing the risk of conversational dominance or withdrawal (Tomprou et al., 2021).

Prior research has explored speaking time as an indicator of group dynamics. For example, Chen et al. (2025b) developed a dashboard for meeting participants that visualised individual speaking times in real-time, encouraging more equal contributions. However, this work focused on visualising raw time metrics without integrating other engagement factors or testing how these visualisations affect user experience. Similarly, in interpersonal support contexts, Bodie and Jones (2012) demonstrated that the quality of verbal and nonverbal listening - particularly verbal person-centeredness - can significantly influence perceptions of empathy. However, their study did not explore dynamic feedback mechanisms during live interactions.

This work builds on these insights by embedding speaking balance into a live feedback interface. Instead of raw time displays, abstract pop-up notifications and race-track visualisations are used to preserve user focus and avoid gamification. Moreover, the system combines speaking balance with interruption and pause data, offering a multi-metric view that enables self-regulation. This approach aims not only to inform but to subtly prompt behavioural shifts in real-time, without external intervention.

Whereas earlier chapters such as Chapter 3 framed engagement largely in terms of perceived familiarity and openness, speaking balance offers a measurable, in-the-moment proxy for mutual participation - a form of engagement not previously captured in the asynchronous context.

Pauses

Pauses - both intra-turn (within a speaker's own turn) and inter-turn (between speakers) - serve critical roles in regulating conversational rhythm, allowing for reflection, floor transfer, or emotional emphasis (Sacks et al., 1974; Zellner, 1994). In co-present conversations, their meaning is often clarified by accompanying non-verbal cues. For example, eye contact may signal an intended turn handover, while posture or facial expression can indicate reflection or uncertainty.

In video-based CMC, these clarifying signals are often lost. As a result, long pauses may be misinterpreted as disengagement, technical failure, or confusion (Fu et al., 2022; Levinson, 2016). This can create anxiety or disrupt conversational flow. Some HCI studies have experimented with real-time representations of pauses - Aseniero et al. (2020), for instance, explored visual indicators (i.e. timers or colour shifts) to help speakers pace themselves. However, such work has typically focused on isolated features or controlled environments.

This research refines this idea by operationalising pause feedback into subtle, colour-coded notifications and counters, distinguishing between intra- and inter-turn silences. The aim is to increase awareness of pausing patterns without eliminating natural silence. By providing just-in-time, non-intrusive visual cues, this approach supports smoother pacing and reduces the cognitive burden of ambiguity in silence, particularly in task-oriented virtual settings.

This builds on Chapter 2's discussion of turn-taking and silence by showing how pauses can now be quantified and surfaced during live interactions, rather than reflected on post hoc.

Interruptions

Interruptions can be either cooperative - used to affirm or support a speaker - or competitive - used to seize the floor or redirect the conversation (Murata, 1994; West and Zimmerman, 2015). In video-mediated interaction, where delays and reduced turn-taking signals are common, overlapping speech often occurs unintentionally (Seuren et al., 2021). Even when meant as support, poorly timed interruptions can increase frustration or reduce conversational clarity.

Previous work by Hilton (2018) distinguished between cooperative and competitive interruptions, showing that supportive interjections can foster engagement and solidarity when perceived positively. However, most automated systems do not make this distinction and instead treat all interruptions as problematic. Bickmore and Cassell (2001) suggested that frequent interruptions - regardless of intent - can impair rapport and should be monitored as a sign of conversational imbalance.

Rather than classifying interruptions by intent (which would require semantic and prosodic analysis, potentially introducing complexity and subjectivity), this system uses timing thresholds to flag overlapping speech exceeding 600ms. Such approaches may also reduce scalability, making real-time feedback impractical in everyday remote settings. By presenting these events neutrally (i.e. "you interrupted" vs. "you were interrupted"), the goal is to raise awareness without assigning blame. This approach encourages participants to reflect on their turn-taking without introducing judgment or disrupting flow, especially in contexts where mutual understanding and participation are key.

While Chapter 3 aimed to reduce awkwardness and dominance before a call began, this metric addresses how interruptions affect balance once the conversation is underway - especially when participants know each other well and may talk more freely.

Synthesis: From Conversational Features to Operational Engagement Metrics

While speaking balance, pauses, and interruptions have each been studied individually in HCI, education, and healthcare, they are rarely operationalised together as a cohesive set of engagement metrics for real-time support in dyadic video communication. Prior work has visualised these features in retrospective dashboards (i.e. DiMicco et al. (2004); Setlur et al. (2024)), embedded them into conversational agents (Følstad and Skjuve, 2019), or analysed them post-hoc for research purposes (Pentland, 2004). However, few systems integrate these cues into a single, live feedback interface designed to encourage user-led behavioural adjustment during conversation.

Unlike earlier approaches that impose behavioural norms or rely on heavy-handed moderation, this work proposes a minimally disruptive alternative: a system that visualises conversational cues in real-time, enabling participants to monitor their own interaction dynamics. In doing so, this work contributes to existing research with a practical, multi-metric framework for engagement awareness in video-based communication - offering a scalable and user-sensitive alternative to fragmented or overly prescriptive feedback methods. Collectively, these metrics operationalise interactional balance within the triangular state framework, offering measurable indicators of how coordination unfolds during synchronous communication without directly intervening in trust or task performance.

Having established the rationale for selecting specific engagement metrics, the next section considers how feedback has been implemented in prior HCI and CMC systems.

4.2.4 Feedback Mechanisms in CMC and HCI

Having outlined the conversational metrics that this research builds upon, the next subsections review how real-time and inter-meeting feedback have been approached in the broader CMC and HCI literature. Chapter 2 introduced these feedback types conceptually; here, the focus shifts to specific systems and design considerations relevant to the real-time feedback intervention developed in this thesis.

In both CMC and HCI, researchers have explored feedback mechanisms to improve interaction quality, particularly in contexts where non-verbal cues are absent or diminished. These mechanisms typically fall into two categories: in-meeting feedback and inter-meeting feedback. While both can influence conversational behaviour, they vary in timing, intrusiveness, and suitability for different interaction types.

Real-Time Feedback

Real-time conversational feedback provides immediate cues about ongoing behaviour, often through on-screen alerts, visual overlays, or peripheral displays. Studies such as Chen et al. (2025a) and Kim et al. (2008) have shown that visual widgets displaying speaking time or turn-taking frequency can help participants self-adjust in the moment. For instance, Kim et al. implemented a real-time dashboard during group discussions that displayed live speaking time to reduce dominance and encourage quieter voices.

However, the design of such systems plays a critical role on how they are perceived. Poorly timed or overly visible feedback may interrupt natural flow, increasing anxiety or reducing spontaneity (D'mello and Graesser, 2013; Sweller, 2020). Faucett et al. (2017), for example, found that real-time prompts designed without regard for conversational subtlety led to rigid, over-managed dialogue. Thus, achieving a balance between visibility and unobtrusiveness is a central challenge in real-time feedback systems for communication.

This emphasis on interface design and perception marks a progression from earlier chapters, which discussed the existence and timing of feedback. Here, the design implications - especially subtlety and user comfort - are treated as core concerns shaping system effectiveness. The race-track interface, introduced in Study 4.5, addresses this limitation by providing a continuous, ambient visualisation that makes turn-taking patterns visible without requiring direct intervention.

Inter-meeting Feedback and Reflective Learning

Inter-meeting feedback offers a delayed alternative, often delivered as post-meeting summaries, visual dashboards, or textual annotations. These tools allow participants to reflect on their conversational style outside the pressures of live interaction. For example, Kim and Baylor (2006) used post-task feedback in collaborative learning settings, helping users gradually develop communication awareness over time.

Out-of-meeting approaches may be well suited for training or slow-building teams (Muresan et al., 2024), but they lack the immediacy required for fast-paced, task-oriented communication. When users must coordinate quickly - as in problem-solving dyads or rapid decision-making - retrospective insights may come too late to be useful. This limitation is particularly salient in remote work contexts, where first-time collaborators are common and the window for rapport-building is short (Raghuram et al., 2019).

Chapter 3 implemented an out-of-meeting approach to improve the meeting space for unfamiliar dyads. This section has shown its limits in fast-paced or synchronous settings - motivating the shift toward real-time feedback for returning or familiar dyads addressed in the present study.

Conversational Agents, Chatbots and Automated Moderation

Another strand of research explores conversational agents and chatbots designed to guide interactions. These systems may prompt turn-taking (Følstad and Skjuve, 2019), re-surface overlooked contributions (Liao et al., 2023), or nudge quieter speakers to engage. In theory, such agents reduce the burden on human moderators and ensure more equitable participation.

However, users often report discomfort when agents feel overbearing or artificially directive (Io and Lee, 2017). When prompts are too frequent or too prescriptive, they risk undermining users' sense of autonomy, making the interaction feel monitored rather than supported. Cassell (2001) and Acikgoz et al. (2025) both highlight the difficulty of aligning system-driven interventions with human conversational norms - especially in informal or creative tasks.

Unlike agent-based moderation, this system does not intervene with instructions or prompts. Instead, it surfaces passive, real-time indicators (i.e. colour-coded counters, race-tracks) that users can choose to interpret and act upon. This self-regulatory model enables behavioural change without enforcing specific actions or disrupting the organic rhythm of dialogue.

Whereas Chapter 2 discussed the potential role of agents in facilitating engagement, this section argues for a lighter-touch, user-driven alternative - more appropriate for familiar dyads, where overt intervention may feel intrusive.

4.2.5 Tools to Support Digital Communication

This subection builds on prior work discussed in Chapter 2 on interface-based engagement systems, but narrows the lens to tools that visualise real-time behaviour - specifically within synchronous, small-scale settings. It contrasts sensor-heavy or domain-specific approaches with the lightweight, speech-based design explored in this thesis.

A wide range of systems in CMC and HCI aim to enhance communication quality in virtual environments, particularly under video-mediated conditions. These tools often integrate analytics, multimodal sensing, or conversational interfaces to address the challenges of limited non-verbal cues. For example, ADELE (Bickmore et al., 2010) uses Artificial Intelligence-driven analytics to personalise virtual health consultations by adapting to user needs in real-time, while Aseniero et al. (2020) employed live visual cues to reduce speaker dominance during group video calls.

Multimodal approaches have also emerged, incorporating gaze tracking or facial affect detection to refine turn-taking. Lockwood and Bergin (2016) used attention tracking to redirect disengaged participants, and Degutyte and Astell (2021) explored how gaze-informed feedback can prompt more inclusive participation in virtual classrooms.

These systems, while promising, tend to rely on complex sensor setups and focus either on general user experience (i.e. attention, affect, fatigue) or highly domain-specific applications (i.e. telehealth, education). Few offer lightweight, real-time interventions directly targeting conversational metrics like pauses, speaking balance, or interruptions.

Moreover, such systems often assume a top-down moderation model - where the system interprets behaviour and actively intervenes. By contrast, this study's approach prioritises user autonomy through surface-level feedback that users interpret and regulate themselves. This difference reflects a design shift away from corrective or agent-driven systems toward supportive, awareness-based tools.

Despite these promising developments, much of the existing HCI research on communication tools continues to prioritise interface design or behavioural outcomes without systematically evaluating user perceptions of stress, disruption, or autonomy - particularly in real-time feedback settings. While systems like those by Aseniero et al. (2020), Dabbish and Kraut (2008), and DiMicco et al. (2004) have shown measurable impacts on turn-taking and participation, their evaluations are often confined to group environments or rely on post-hoc analysis dashboards, overlooking the subtleties of live dyadic interaction.

To address these limitations, the present research targets four key gaps in the literature:

- **Real-Time, Non-Intrusive Feedback in HCI Systems:** Many HCI prototypes for real-time conversational support rely on high-visibility popups, alerts, or embodied agents that can disrupt conversational flow (D'mello and Graesser, 2013; Dabbish and Kraut, 2008). While these systems often track engagement-related metrics, few have been evaluated in terms of perceived user comfort, stress, or naturalness of interaction - key aspects when designing for fluid human conversation.
- **Holistic Integration of Conversational Metrics in HCI Interfaces:** Prior work in HCI has addressed single features like speaking time or turn frequency (i.e. DiMicco et al. (2004); Aseniero et al. (2020), but rarely integrates multiple engagement cues (interruptions, pauses, balance) into one real-time, end-user-facing system. This limits ecological validity and fails to reflect the layered complexity of dyadic conversation.
- **Support for Fast-Forming, Task-Oriented Teams:** Much HCI literature focuses on long-term collaboration or training, often using out-of-meeting dashboards or post-hoc analysis (Muresan et al., 2024). However, little work evaluates real-time support for unfamiliar, short-term video interactions - despite their growing prevalence in modern teamwork and online collaboration (Raghuram et al., 2019).

- **User Autonomy and Self-Regulation vs. Prescriptive Systems:** HCI systems that rely on conversational agents or rule-based moderation risk being overly directive Io and Lee (2017). There is a need for interfaces that respect user autonomy by supporting awareness without judgement - offering feedback as an ambient guide, not an authoritative correction.

This research addresses these gaps by evaluating a lightweight, real-time feedback system across two empirical studies, with a focus on behavioural outcomes, satisfaction, and the perceived subtlety and agency of feedback. In contrast to the asynchronous interventions described in Chapter 3, the approach taken here supports interaction as it unfolds. This reflects the broader shift in the thesis from preparing participants before communication (Chapter 3) to empowering them during communication through real-time engagement feedback.

4.3 Apparatus: Engagement Metrics - Definitions and Real-Time Computation

This research operationalises three core engagement metrics - speaking balance, pauses, and interruptions - as quantifiable features of speech that can be computed in real-time without the need for specialised hardware such as gaze or pose sensors (i.e. Truong and Leeuwen (2005); Vertegaal et al. (2001)). These metrics act as behavioural proxies for conversational engagement, helping capture subtle dynamics like dominance, responsiveness, and rhythm in dyadic video calls.

Speaking balance is measured by calculating the total speaking time for each participant within a session and comparing the difference. A significant imbalance can signal conversational dominance or disengagement, which previous studies have linked to lowered satisfaction and reduced collaborative effectiveness (DiMicco et al., 2004).

Pauses are divided into two types: intra-pauses, defined as within-speaker silence lasting over 2 seconds, and inter-pauses, defined as between-speaker silence lasting over 4 seconds. These thresholds are informed by work in conversational analysis (Heldner and Edlund, 2010) and distinguish moments of hesitation or breakdown in conversational flow, which may hinder perceived fluency and mutual engagement.

Interruptions are detected as overlapping speech events lasting longer than 600 milliseconds, excluding brief backchannels like ”mhm” or ”yeah”. This threshold helps filter out cooperative overlaps while identifying potential conversational friction or miscoordination, which can disrupt turn-taking and rapport (Murata, 1994).

Together, these metrics form the computational basis for the real-time feedback systems explored in both studies, enabling structured awareness of conversational dynamics without relying on complex or intrusive sensing technology.

Real-Time Feedback in HCI/CMC

Real-time conversational feedback provides immediate cues about ongoing behaviour, often through on-screen alerts, visual overlays, or peripheral displays. Studies such as Terken and Sturm (2010) and Kim et al. (2006) have shown that visual widgets displaying speaking time or turn-taking frequency can help participants self-adjust in the moment. For instance, Li et al. implemented a real-time dashboard during group discussions that displayed live speaking time to reduce dominance and encourage quieter voices.

However, the design of such systems plays a critical role in how they are perceived. Poorly timed or overly visible feedback may interrupt conversational flow, increase anxiety, or reduce spontaneity (D'mello and Graesser, 2013; Sweller, 2020). Bickmore and Cassell (2001), for example, found that real-time prompts designed without regard for conversational subtlety led to rigid, over-managed dialogue. Thus, achieving a balance between visibility and unobtrusiveness remains a central challenge in real-time feedback for communication systems.

Building on this foundation, the following two studies examine how real-time engagement metrics can be integrated into user-facing systems that aim to support self-regulated communication in dyadic video calls.

4.4 Study 1: Exploring Awareness of Engagement Metrics in Dyadic Video-Based Meetings to Understand Interaction, Engagement, and User Preferences

This study was designed to investigate how awareness of specific engagement metrics might influence participants' interaction patterns, user preferences, and perceived engagement quality during video-based communication. Participants were recruited in dyads to preserve familiarity and each dyad completed two video-based meetings separated by a break. To explore how feedback timing impacts behaviour, the study compared two conditions: one group received feedback only between meetings (inter-meeting), while the other received both inter-meeting feedback and additional real-time (in-meeting) prompts during the second call. This approach allowed assessment of whether either, or both, feedback timings could improve self-awareness and conversational flow. The study is novel in its combination of inter-meeting reflection with

a Wizard-of-Oz-simulated real-time system deployed in a naturalistic Zoom environment. Unlike prior work that typically focuses on post-hoc analysis or a single feedback channel, this study directly compares the effects of feedback timing and delivery mode (inter-meeting vs. in-meeting) on user awareness, behaviour, and preferences, using structured, manually-triggered cues grounded in engagement metrics. Within the governing stance of the triangular state of team dynamics, this study treats real-time engagement feedback as a mechanism for supporting self-regulation under cognitive load during live video interaction. Disrupted turn-taking cues and delayed feedback increase the attentional demands placed on participants, making it difficult to monitor balance, interruptions, and pauses in real time. By externalising these dynamics through structured engagement metrics, the system reduces the need for continuous internal monitoring, allowing participants to adjust behaviour with minimal disruption. SIPT is only used contextually to explain why degraded or misaligned cues in video interaction become socially consequential, but the intervention itself is justified through the Cognitive Load Theory and self-regulation perspectives rather than cue compensation alone. By introducing structured engagement metrics as visual signals, this study offers users compensatory mechanisms that support coordination and social awareness in the absence of rich non-verbal cues.

4.4.1 Research Questions

Building on the broader aims introduced in the Related Work section, this study focuses specifically on how the timing and type of feedback shape interaction in dyadic video meetings. To address the challenges identified - such as limited research on feedback timing and the difficulty of offering non-intrusive guidance - Study 1 investigates:

- **Q1:** How does awareness of engagement metrics influence behavioural interaction and self-regulation in video-based dyadic meetings?
- **Q2:** In what ways do different feedback timings (inter-meeting vs. inter-meeting + in-meeting, real-time) affect user preferences, engagement outcomes, and conversational flow?

These questions aim to clarify how feedback delivery methods impact not only observable conversational behaviours but also user perceptions, comfort, and sense of control. While prior research has examined these aspects in isolation, few studies have evaluated them together. Establishing these foundational insights was essential for informing the design of real-time feedback systems that promote balanced, engaging, and minimally stressful online conversations.

4.4.2 Study Design and Methodology

Participants and Recruitment

A total of 28 participants were recruited, forming 14 dyads. Each dyad consisted of individuals who already knew one another, so as to create a comfortable, realistic environment reflective of everyday online communication. Familiarity was important to reduce artificial or overly polite behaviour often seen among strangers, and to encourage more natural interactions. Prior research (i.e. Clark and Brennan (1991); Latané and Bourgeois (2001)) has shown that shared context and trust can meaningfully affect conversation dynamics in remote settings.

All participants were informed that the study investigated social engagement and communication styles in online contexts; however, they were not told about the specific metrics (interruptions, pauses, speaking balance) being observed. This partial information ensured that participants' baseline behaviours remained as authentic as possible.

Before the sessions began, each participant completed a pre-study questionnaire (Appendix B.2.1) collecting demographic data, Big Five personality traits (John and Srivastava, 1999), and personal interests. Conversation prompts were later tailored to these interests (Appendix B.2.4), maximising relevance and conversational ease.

This study received ethical approval from the University of Southampton Ethics Committee (ERGO ID: 82068). Participants were provided with a detailed Participant Information Sheet and gave informed consent prior to the study. A copy of the Participant Information Sheet is included in Appendix B.1

Procedure

Each dyad completed two structured 10-minute Zoom sessions, spaced by a short break during which feedback was delivered.

- **First Session (10 minutes):** After a brief introduction, participants began a free-form conversation based on shared interests or optional prompts. Throughout this session, the experimenter passively observed and manually tracked interruptions, extended pauses, and speaking-time imbalances (i.e. monologues lasting over 60 seconds).
- **Break & Feedback Delivery (5 minutes):** Participants were given a short break between the two sessions.
  - In Condition 1 (C1), participants received only inter-meeting feedback - a private summary sheet showing their frequency of interruptions, pauses, and monologues from the first session (see Figure 4.1).

  - In Condition 2 (C2), participants received the same summary sheet and were also informed that they would receive real-time feedback during the second session in the form of on-screen notifications.

- **Second Session (10 minutes):** Participants resumed conversation on Zoom.
  - In C1, participants relied solely on the inter-meeting feedback summary to guide any changes in their behaviour.
  - In C2, participants received real-time pop-up notifications during the session, triggered manually by the experimenter via a shared visual interface (see details in the following section).

- **Post-Experiment Questionnaire:** After the second session, participants completed an open-ended questionnaire exploring their perceptions of the feedback experience, including comfort, stress, and engagement (see Appendix B.2.2 for Condition 1 and Appendix B.2.3 for Condition 2).

To ensure fluid and engaging conversations between familiar dyads, discussion topics were tailored to participants' personal interests (i.e. music, travel, cooking, aviation), as recorded in the sign-up questionnaire (Appendix B.2.1). Prior work has shown that shared interests and self-relevant themes increase engagement and reduce communicative awkwardness in partner interactions (Aron et al., 2000; Sun and Taylor, 2020; Toma and Hancock, 2010). Familiar dyads benefit particularly from prompts that activate mutual familiarity or overlapping preferences, as this promotes natural turn-taking and co-construction of dialogue (Clark, 1996; Giles et al., 1991). Topics such as travel and food have been found to encourage elaboration and storytelling, supporting conversational flow in informal settings (Eggins and Slade, 2004; Bavelas et al., 2000). In this study, participants discussed a diverse set of themes such as favourite travel destinations, shared music tastes, personal cooking habits, and opinions on aviation or flying experiences - topics chosen for their versatility and potential to spark informal, collaborative dialogue. To maintain variety and prevent rehearsed exchanges, additional fun facts and conversational headlines were included, drawn from a wide range of trivia websites, entertainment media, and general knowledge platforms. The full list of prompts used is provided in Appendix B.2.4. This design choice aligns with research suggesting that playful or curiosity-driven prompts can help lower conversational barriers and foster mutual disclosure (Fredrickson, 2001; Reeves and Read, 2009).

This study did not include a "no feedback" condition or a "real-time only" condition. A control condition without feedback was omitted as prior research (see Section 4.2) already establishes that providing feedback on conversation dynamics influences communication behaviours. The aim of this study was not to determine whether feedback has an effect, but rather which types of feedback - and in what combination - most effectively support engagement. A "real-time only" condition was also excluded for two

key reasons: (1) to avoid placing participants in a cognitively demanding setting without any prior scaffolding for reflection, which might have increased stress or reduced conversational spontaneity; and (2) because real-time feedback alone would not allow for comparative baselining, making it harder to interpret whether observed behaviours stem from the feedback itself or from initial reaction to novelty. Therefore, this study focused on comparing a purely inter-meeting condition with a combined inter-meeting + real-time condition to balance reflection and immediacy. Inter-meeting feedback was included to give participants an opportunity to reflect without disrupting conversational flow.

From an experimental design perspective, the study does not implement a full factorial or baseline-controlled design. Instead, it adopts a feasibility-oriented, mixed within-dyad and between-condition structure. The within-dyad comparison between the first and second meetings provides a reference point for behavioural change, while the between-condition comparison isolates differences in feedback timing. A no-feedback baseline and a real-time-only condition were deliberately omitted to limit participant burden, reduce stress in early exposure to feedback, and prioritise design feasibility over causal completeness. As a result, findings from Study 1 are interpreted as evidence of intervention sensitivity and user response, rather than as definitive causal effects of feedback timing.

FIGURE 4.1: Feedback sheet provided electronically to participants individually and privately during the 5-minute inter-session break. Participants were instructed to review the feedback independently, which highlighted their engagement metrics from the first session, before joining the second Zoom meeting. They were invited to return to the experiment once they confirmed they had read and understood the feedback.

FIGURE 4.2: Screenshot of the real-time feedback setting on the Miro platform. Participants were instructed to keep Miro open on half of their screen alongside the Zoom meeting, positioning their view to display only their assigned feedback box (indicated by their participant ID). Real-time notifications (right) would appear within this box when triggered by the experimenter, preventing participants from viewing each other's feedback and maintaining privacy of engagement cues.

Apparatus: Framework of Inter-Meeting and In-Meeting Feedback

All dyadic sessions were conducted via Zoom, with participants' video streams enabled throughout. While sessions were not recorded, the experimenter observed passively in the background to manually track key interaction metrics such as interruptions, pauses, and speaking balance.

- **Inter-Meeting Feedback Sheets (Figure 4.1):** For both experimental conditions, participants received an inter-session summary document (as an image or PDF) outlining their engagement metrics from the first session. These sheets used simple icons and minimal text to support quick comprehension and reduce cognitive load or potential defensiveness (Bickmore and Cassell, 2001).
- **Real-Time Pop-ups (Wizard-of-Oz - Figure 4.2):** In the combined feedback condition (C2), participants also received immediate feedback notifications during

the second session. These notifications were manually triggered by the experimenter using a Wizard-of-Oz method. The feedback appeared as discreet messages within a shared Miro board (an interactive digital whiteboard platform) that participants had open alongside their Zoom call. Each participant could see only their own messages 0 or example, ”You spoke for over 60 seconds” or ”You just interrupted”.

The design restricted real-time feedback to personal behaviours only (i.e. not showing data about the partner), with the aim of promoting self-regulation without causing embarrassment or defensiveness. The Wizard-of-Oz setup served as a design probe to simulate a real-time system in a controlled, low-risk setting, allowing user reactions to be studied without introducing computational delays or automation errors.

Architecture & Tools for Wizard-of-Oz

A Wizard-of-Oz setup was used to simulate real-time feedback notifications without building a fully automated system. This approach allowed for testing the feasibility and user acceptance of immediate engagement cues (interruptions, pauses, speaking balance) before undertaking the more complex task of full automation.

Platforms and Interfaces:

- Zoom was used for videoconferencing: participants joined using their personal devices, with cameras on;
- Miro Board acted as the ”feedback display” area, shared separately from Zoom’s interface so that each participant saw only their own notifications. The board was arranged in two hidden ”boxes”, each assigned to one participant;
- A secondary, private interface in Miro was visible only to the experimenter (the ”Wizard”). This interface provided quick buttons or toggles to send one of several feedback pop-ups (i.e. ”You interrupted!” etc.) to a specific participant’s section of the Miro board.

Wizard’s Workflow:

- The experimenter quietly observed the Zoom call, noting events such as an unintentional interruption, a speaker dominating for too long, or an overly long pause;
- Upon detecting a relevant cue, the experimenter triggered the notification from the private Miro panel. This instantly displayed a colored pop-up in the target participant’s box - for example, a red panel reading ”You interrupted”;

- To ensure consistent triggering, simple decision rules were followed: (a) interruption if a participant started speaking on top of their partner for approximately 1 second and counting; (b) long monologue if a participant talked continuously for more than 60 seconds; (c) pause if a speaker seemed to trail off or left a silence longer than 2 seconds (for intra-pauses) or 4 seconds (for inter-pauses).

Timing, Logging, and Consistency:

- The Wizard tried to send each feedback notification within 2–3 seconds of the observed event, preserving the illusion of automation;
- For consistency, the experimenter followed a short "Wizard Handbook" - a summary of the rules outlined earlier in the Engagement Metrics Section 4.3 - which included examples of borderline cases (i.e. is "mm-hmm" an interruption?) and defined how metrics such as interruptions and pauses were operationalised during the session;
- Each triggered feedback event was time-stamped in a simple Google spreadsheet, noting the condition (C1 or C2), which participant it was for, and the reason for triggering (i.e. interruption vs. pause). This log helped verify how often feedback was actually served and cross-check it against participants' subjective perceptions.

The decision to use a Wizard-of-Oz approach arose from time and complexity constraints: building a fully automated system capable of reliably detecting overlapping speech, extended pauses, and speaking-time imbalance would require substantial development (i.e. speech transcription, machine learning). Wizard-of-Oz allowed to rapidly prototype the experience of real-time feedback without the risk of frequent false positives from imperfect algorithms. Insights gained here guided the design of the automated system in Study 2, where the human Wizard was replaced with programmatic detection once it was validated that real-time feedback was desirable and feasible.

Data Collection

Engagement metrics were recorded in real-time by the experimenter. Interruptions were defined as attempts to seize the floor mid-turn (Beattie, 1981). Pauses were subdivided into intra-pauses and inter-pauses if they exceeded two seconds and four seconds respectively (Heldner and Edlund, 2010). Speaking time was tracked to note extended monologues (more than 60 seconds), reflecting possible dominance of the conversation (Samrose et al., 2020).

The post-experiment questionnaires (Appendix B.2.2 for C1 and Appendix B.2.3 for C2) captured participants' reflections on user awareness, comfort, stress, and feedback preferences. Alongside open-ended questions designed to elicit rich qualitative data, the

questionnaire also included a set of Likert-scale items measuring participants' awareness of engagement metrics both before and after receiving any feedback. These items aimed to prompt reflection on whether participants were consciously attentive to their own speaking behaviours - i.e. interruptions, pauses, and balance - across the two meetings. C2 participants additionally provided input on how real-time notifications affected their engagement. Thematic insights from these responses are presented in the Discussion, Section **??**.

Data Analysis

Quantitative measures of engagement (interruptions, pause counts, speaking balance) were analysed to identify any pre-post or between-conditions changes. Depending on data distribution, t-tests or non-parametric analyses (i.e. Wilcoxon) were performed. Subjective questionnaire responses were examined using a thematic approach, identifying common experiences and attitudes about feedback intrusiveness, utility, and overall engagement improvements. Given the absence of a no-feedback baseline and the mixed within-and between-dyad structure, statistical analyses are used to examine directional change and relative sensitivity rather than to establish causal attribution. This qualitative analysis focused on participants' interpretations of engagement and feedback, rather than analysing the sequential organisation of task interaction itself.

4.4.3 Results

Study 1 involved 28 participants, with ages ranging from 18 to 54 years. The age distribution showed a majority of participants (50.0%) in the 25–34 age group, representing 14 individuals. This was followed by the 45–54 age group with 6 participants (21.4%), the 35–44 age group with 5 participants (17.9%), and the 18–24 age group with 3 participants (10.7%). The mean age of the participants was approximately 34.3 years, with a Std. Dev.= 10.1 years. In terms of gender distribution, 14 participants (50.0%) were male and 14 participants (50.0%) were female.

The quantitative analysis for Study 1 focused on comparative assessments of engagement metrics across conditions and meetings. First, behavioural data - interruptions, intra-pauses, inter-pauses and speaking balance - is analysed separately for participants in C1 and C2 to examine how each feedback type influenced interaction patterns. Table 4.1 presents descriptive statistics and Shapiro-Wilk test results to assess the normality of these metrics across meetings. Table 4.2 reports the inferential statistics (t-tests and Wilcoxon tests) comparing each metric between the first and second meetings, highlighting significant behavioural changes within conditions.

Participants' self-reported awareness of engagement metrics is also analysed. Table 4.3 provides descriptive statistics and normality test results for awareness scores, which were derived from Likert-scale responses (1 = Not at all aware, 5 = Extremely aware)

in both meetings. Table 4.4 presents the results of paired t-tests comparing awareness scores between the first and second meetings across all participants, regardless of condition. By aggregating C1 and C2 scores, it is aimed to identify overall perceptual changes in engagement awareness that might occur simply from participating in the study, independent of feedback modality. This allowed examination of broader trends in user awareness across both groups, beyond the specific effects of synchronous, inter-meeting or in-meeting, real-time feedback. Together, these analyses evaluate both condition-specific behavioural outcomes and overarching patterns of engagement awareness.

A. Behaviour/Real Tracked Data

TABLE 4.1: Descriptive Statistics for each Engagement Metric in each of the two conditions, along with the Shapiro-Wilk test of normality.

Condition	Metric	First Meeting					Second Meeting				
		Descriptive Stats			Shapiro-Wilk Normality Test		Descriptive Stats			Shapiro-Wilk Normality Test	
		Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.	Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.
C1	**Interruptions**	6.86	2.74	0.73	0.965	0.801	2.86	2.32	0.62	0.876	0.051
	Intra-pauses	4.5	2.53	0.68	0.924	0.251	3.14	2.21	0.59	0.949	0.551
	Inter-pauses	15.29	9.11	2.43	0.838	0.015	8.86	5.3	1.42	0.92	0.221
C2	**Interruptions**	7.86	4.82	1.29	0.955	0.635	3.36	2.65	0.71	0.878	0.054
	Intra-pauses	5	4.47	1.2	0.719	0.00059	3.14	2.8	0.75	0.804	0.0057
	Inter-pauses	5.86	2.85	0.76	0.0019	0.044	4.14	2.63	0.7	0.803	0.0054

TABLE 4.2: Comparison of Interruptions, Intra-Pauses, and Inter-Pauses Between First and Second Meetings for all participants. This table includes statistical test outcomes (T-Test or Wilcoxon Test), with corresponding test statistics and p-values. Speaking balance was excluded from this table as it was tested separately using a binomial test under Hypothesis H1.4, due to the binary nature of that outcome (i.e. whether the speaking balance changed or remained stable between meetings). Results in this table highlight significant behavioural changes across the two meetings, emphasising differences in participant interaction patterns.

Condition	**C1**			**C2**		
Metric	Interruptions	Intra-pauses	Inter-pauses	Interruptions	Intra-pauses	Inter-pauses
p-value	0.00024	0.057	0.00012	0.0013	0.032	0.058
t-value/Wilcoxon Statistic	5.45 (t-test)	2.01 (t-test)	1.5 (Wilcoxon)	3.54 (t-test)	1.6 (Wilcoxon)	1.8 (Wilcoxon)
Mean-difference	4.0	1.36	6.43	4.5	1.86	1.71

H1.1: There is a significant difference in the use of interruptions between meetings for participants in condition C1.

The hypothesis is confirmed as there is a statistically significant decrease in the use of interruptions between the first meeting (Mean = 6.86, Std. Dev. = 2.74) and the second meeting (Mean = 2.86, Std. Dev. = 2.32) for participants in condition C1 ($p = 0.00024$, $p < 0.05$).

H1.2: There is a significant difference in the use of intra-pauses between meetings for participants in condition C1.

The hypothesis is not confirmed as there is no statistically significant difference in the use of intra-pauses between the first meeting (Mean = 4.5, Std. Dev. = 2.53) and the

second meeting (Mean = 3.14, Std. Dev. = 2.21) for participants in condition C1 (p = 0.057, p $>$ 0.05).

H1.3: There is a significant difference in the use of inter-pauses between meetings for participants in condition C1.

The hypothesis is confirmed as there is a statistically significant decrease in the use of inter-pauses between the first meeting (Mean = 15.29, Std. Dev. = 9.11) and the second meeting (Mean = 8.86, Std. Dev. = 5.30) for participants in condition C1 (p = 0.00012, p $<$ 0.05).

H1.4: There is a significant difference between speaking time between the first and the second meeting for participants in C1.

For this hypothesis, a binomial test was utilised due to the binary nature of the outcome - either the speaking balance changed (one participant spoke more than the other, noted as P1 $>$ P2) or it remained the same. Since it is unrealistic for two participants to speak for exactly the same duration, "the same" was defined using a tolerance threshold: speaking times were considered balanced if the difference between participants' total speaking times did not exceed 10% of the total session duration. The binomial test is particularly suitable here for several reasons: it is designed to analyse categorical data; it effectively handles situations with binary outcomes; and it is appropriate for the small sample size of 7 C1 groups in this study. Upon examination, it was found that in 4 out of the 7 groups, the speaking balance did not change between the two meetings, while in 3 groups, there was a change. A p-value of 1.0 was obtained, indicating that there is no statistically significant difference between the observed proportion of cases where the speaking balance remained the same and what would be expected by chance, assuming a 50% probability that the speaking balance would either remain the same or change between the meetings. This result suggests that any variations in speaking balance between the meetings for participants in condition C1 occur randomly and are not statistically significant.

H2.1: There is a significant difference in the use of interruptions between meetings for participants in condition C2.

The hypothesis is confirmed as there is a statistically significant decrease in the use of interruptions between the first meeting (Mean = 7.86, Std. Dev. = 4.82) and the second meeting (Mean = 3.36, Std. Dev. = 2.65) for participants in condition C2 (p = 0.0013, p $<$ 0.05).

H2.2: There is a significant difference in the use of intra-pauses between meetings for participants in condition C2.

The hypothesis is confirmed as there is a statistically significant decrease in the use of intra-pauses between the first meeting (Mean = 5.0, Std. Dev. = 4.47) and the second

meeting (Mean = 3.14, Std. Dev. = 2.80) for participants in condition C2 ($p = 0.032$, $p < 0.05$).

H2.3: There is a significant difference in the use of inter-pauses between meetings for participants in condition C2.

The hypothesis is not confirmed as there is no statistically significant difference in the use of inter-pauses between the first meeting (Mean = 5.86, Std. Dev. = 2.85) and the second meeting (Mean = 4.14, Std. Dev. = 2.63) for participants in condition C2 ($p = 0.058$, $p > 0.05$).

H2.4: There is a significant difference between speaking time between the first and the second meeting for participants in C2.

For hypothesis H2.4, a binomial test was used due to its suitability for binary outcomes - specifically, whether the speaking balance changed or remained the same. The findings reveal that in only 1 of these groups, the speaking balance remained within the defined threshold (i.e. less than a 10% difference between participants), while in 6 groups, a noticeable imbalance was observed. Despite this apparent shift, the binomial test yielded a p-value of 0.125, indicating that the change in speaking balance between the first and second meetings for participants in C2 was not statistically significant. This result suggests that while there may appear to be a trend towards changing speaking balance, it does not significantly deviate from what might be expected by chance, assuming a 50% probability of change.

B. Perceptions: Likert Scales (Awareness of Engagement Metrics Pre and Post Feedback)

H3.1: There is a significant difference between people's awareness of interruptions between the first meeting and the second meeting.

TABLE 4.3: Descriptive statistics and Shapiro-Wilk normality test results for awareness of engagement metrics in the first and second meetings, where Likert scale responses were transformed into scores ranging from 1 (Not at all aware) to 5 (Extremely aware).

Metric	Before Feedback					After Feedback				
	Descriptive Stats			Shapiro-Wilk Normality Test		Descriptive Stats			Shapiro-Wilk Normality Test	
	Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.	Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.
Interruptions	2.78	1.13	0.21	0.871	0.002	4.39	0.83	0.15	0.681	0.000
Pauses	2.96	0.92	0.17	0.828	0.000	4.21	0.83	0.15	0.809	0.000
Speaking balance	3.21	1.19	0.22	0.916	0.028	4.25	0.92	0.17	0.769	0.000

TABLE 4.4: Paired t-test results comparing awareness of engagement metrics between the first and second meetings.

Metric	**Interruptions**	**Pauses**	**Speaking balance**
p-value	0.000	0.000	0.000
t-value	-7.10	-7.83	-5.69
Mean-difference	-1.61	-1.25	-1.04

There is a significant difference between people's awareness of interruptions between the first meeting (Mean = 2.79, Std. Dev. = 1.13) and the second meeting (Mean = 4.39, Std. Dev. = 0.83) for participants in conditions C1 and C2 (t = -7.11, p = 0.000, $p < 0.05$).

H3.2: There is a significant difference between people's awareness of pauses between the first meeting and the second meeting.

The analysis yielded that there is a significant difference between people's awareness of pauses between the first meeting (Mean = 2.96, Std. Dev. = 0.92) and the second meeting (Mean = 4.21, Std. Dev. = 0.83) for participants in conditions C1 and C2 (t = -7.83, p = 0.000, $p < 0.05$).

H3.3: There is a significant difference between people's awareness of speaking balance between the first meeting and the second meeting.

Based on the results of the analysis, there is a significant difference between people's awareness of speaking balance between the first meeting (Mean = 3.21, Std. Dev. = 1.20) and the second meeting (Mean = 4.25, Std. Dev. = 0.93) for participants in conditions C1 and C2 (t = -5.70, p = 0.000005, $p < 0.05$).

4.4.4 Discussion

The findings from Study 1 provide valuable insights into how feedback modalities specifically inter-meeting and combined inter-meeting and in-meeting, real-time feedback affect participants' conversational behaviours and awareness of engagement metrics in a dyadic video-based setting.

Interruptions

For both conditions (C1 and C2), interruptions decreased significantly between the first and second meetings, as shown by the results of H1.1 and H2.1. Participants in both conditions reduced their frequency of interruptions after receiving feedback, suggesting that awareness - whether through inter-meeting feedback alone or combined with real-time notifications - can lead to behavioural adjustments. This supports prior research indicating that feedback encourages individuals to reflect on and adjust their communication style (i.e. Bickmore and Cassell (2001)). Notably, while both conditions showed reductions, participants in C2 received real-time pop-ups that may have enabled more immediate self-regulation by drawing attention to the behaviour as it occurred. Although this study did not statistically compare the magnitude of change between conditions, qualitative comments suggest that real-time cues prompted in-the-moment awareness and correction. This finding points to the value of further research into how synchronous, inter-meeting and in-meeting, real-time feedback can be optimally combined to maximise conversational improvements - an issue addressed more

directly in Study 2. Overall, these findings demonstrate that interruption-specific engagement metrics can be translated into lightweight, manual feedback mechanisms that meaningfully reduce disruptive conversational behaviours - without the need for physical sensors or embodied agents.

Pauses

The analysis of pauses revealed mixed results across individual and inter-pauses. For C1, H1.2 showed no significant difference in intra-pauses between meetings, while H1.3 indicated a significant reduction in inter-pauses. This suggests that while participants did not significantly alter their own intra-turn pauses, they became more conscious of inter-turn dynamics, likely aiming to reduce overlap or prolonged silences when taking turns, possibly due to the reflective nature of inter-meeting feedback (Sacks et al., 1974). In contrast, participants in C2 showed a significant reduction in intra-pauses (H2.2) but not in inter-pauses (H2.3). This may imply that real-time feedback helped participants self-regulate more within their own turns, possibly due to a heightened awareness of their personal speech patterns. The discrepancy between intra and inter-pause adjustments highlights the complex influence of feedback type on different aspects of pausing behaviour. This aligns with findings by Heldner and Edlund (2010), who noted that participants respond differently to intra- and inter-turn pauses, as intra-turn pauses are often perceived as moments of cognitive processing, while inter-turn pauses signal potential turn transitions and social coordination. This suggests that feedback might need to be tailored specifically to address each type of pause behaviour to improve conversational fluidity in CMC settings. This also underscores a literature gap: most prior systems did not test intra- vs. inter-turn pauses separately, nor link them to user perceptions of engagement. By separating these dimensions, this study identifies distinct behavioural effects and supports the design of metric-specific feedback.

Speaking Balance

The analysis of speaking balance, however, showed no significant changes in either condition. This result may suggest that without explicit prompts targeting speaking duration, participants default to their natural interaction patterns, particularly in dyadic interactions with familiar partners. Studies such as those by Bavelas et al. (2000) and Bodie et al. (2012) suggest that speaking balance may require more directive feedback or specific goals to prompt noticeable change. From a Cognitive Load Theory perspective, monitoring one's own speaking duration while simultaneously attending to task content and partner cues places a high self-regulatory demand on participants, making subtle or indirect feedback insufficient to prompt behavioural change. These findings suggest that more visually engaging and directive feedback mechanisms such as a race-track visualisation planned for Study 2 may be required to effectively encourage speaking balance adjustments. This progression toward enhanced, real-time

visualisations aims to address the limitations observed in Study 1, where more explicit prompts are needed to influence conversational dynamics effectively.

Qualitative Responses

Qualitative responses were analysed using RTA, treating meaning as co-constructed through participant accounts and researcher interpretation. The analysis was not intended to reconstruct task interaction turn-by-turn, but to interpret how participants made sense of feedback timing, awareness, and comfort in relation to their conversational behaviour.

Several distinct patterns emerged across the two conditions that illustrate how different types of feedback influenced social engagement, awareness, and comfort levels. Participants in C1 often reflected on the information they received between sessions, noting that it encouraged them to adjust their communication style in subsequent interactions. The delayed nature of feedback allowed participants to process and reflect on their conversational habits without immediate pressure, which fostered a more relaxed sense of engagement and adaptation over time. This aligns with findings in the literature that suggest feedback, when given out of the meeting space, can promote self-reflection and gradual behavioural shifts without overwhelming the participant (Gabelica et al., 2012). P14 explicitly stated *"The feedback helped me realise how often I interrupted and gave me time to work on improving it"*. Similarly, P7 reflected *"having the summary gave me the chance to adjust without feeling rushed - it was helpful"*.

In contrast, C2 participants reported mixed reactions to receiving immediate feedback on their conversational behaviours. The real-time notifications heightened participants' awareness of specific behaviours like interruptions and pauses, often prompting immediate adjustments. However, this feedback was sometimes perceived as intrusive, disrupting the natural conversational flow and inducing feelings of stress or self-consciousness. For example, P5 noted *"the notifications made me hyper-aware of my pauses, which was helpful but also a bit overwhelming"*. On the other hand, P2 found the immediacy beneficial, saying *"I noticed the interruptions right away and was able to stop myself in the moment, which made it [the conversation] smoother"*. Studies have shown that real-time feedback can indeed increase awareness but may also trigger anxiety in performance-driven settings (Klonek et al., 2014). Participants' preferences for visual or textual feedback in C2 further highlighted the need for customisable feedback systems to accommodate individual comfort levels and reduce stress. P6 shared the visual symbols were *"easier to process and didn't distract too much"*, whereas P10 preferred written summaries: *"the text gave me more context and allowed me to reflect at my own pace"*.

The comparison between C1 and C2 also revealed a perceptual difference: while C1 participants experienced feedback as a tool for long-term improvement in their communication, C2 participants viewed it as an immediate corrective measure that influenced their conversation style on the spot. P8 felt *"like I had time to think and improve*

later", whilst P27 stated they *"had to adjust right away, which felt more intense"*. This difference emphasises the potential for Study 2 to explore feedback delivery methods that balance immediacy with participant comfort, possibly by enhancing feedback visualisation techniques to support quick adaptation without negatively impacting engagement.

The awareness metrics across both conditions indicate that feedback effectively heightens participants' self-awareness of engagement behaviours, with both C1 and C2 feedback significantly increasing awareness of interruptions, pauses, and speaking balance. Awareness of interruptions was particularly notable, supporting findings by Bailenson et al. (2008) and Wiederhold (2020) that feedback increases immediate self-awareness, which in turn facilitates behavioural adjustments that can enhance engagement quality. For instance, P11 from C1 mentioned *"seeing how often I interrupted made me more conscious of giving others space to talk"*. Similarly, P16 remarked *"[pausing so much] made me more aware of how I was affecting the flow"*. The significant increase in awareness of pauses and speaking balance, though less dramatic than for interruptions, underscores the value of feedback in prompting participants to consider various dimensions of their conversational style. P13 shared *"I realised I wasn't contributing enough and started speaking up more to balance the conversation"*. In contrast, P3 noticed *"I talked too much without giving [their partner] space and it helped me adjust and let them share more"*. These insights reinforce the need for flexible feedback systems tailored to individual tolerance and task context. The variability in how users responded to the Wizard-of-Oz feedback highlights a critical gap in current literature: a lack of user-centred design in real-time systems. Study 2 directly addresses this by co-designing feedback styles informed by this qualitative data.

Implications for Understanding Engagement in Video-based Communication Platforms

The implications of these findings are multifaceted. First, the study demonstrates that both synchronous inter-meeting and in-meeting real-time feedback can effectively enhance awareness of engagement metrics, which is crucial for promoting equitable and cooperative interaction in digital settings. Enhanced awareness of interruptions, pauses, and speaking balance enables participants to self-reflect, self-regulate and adjust their behaviours without requiring inferential interpretation of ambiguous social cues. For example, P9 commented the feedback made them *"think about how I come across and made the conversation feel more equal"*. This has significant implications for platforms where collaboration and smooth conversational flow are essential, as it suggests that feedback can be a tool for creating a more engaging and less disruptive communication environment.

Additionally, the study emphasises that feedback timing plays a crucial role in influencing specific types of engagement behaviours. Real-time feedback appears more effective in addressing immediate intra-turn behaviours, such as interruptions and intra-pauses, by providing direct cues that users can respond to promptly. P4 noted *"notifications were like a wake-up call"*. In contrast, inter-meeting feedback fosters reflection on inter-turn dynamics, allowing participants to adjust behaviours like inter-pauses more thoughtfully. P17 reflected *"The summary after the session gave me the chance to process what happened and plan for next time"*. This distinction between intra- and inter-turn behaviours can inform the design of feedback mechanisms, suggesting a need for tailored feedback approaches depending on the type of engagement metric being targeted.

Lastly, the study underscores the complexity of influencing speaking balance in familiar dyads. The lack of significant changes in speaking balance across both conditions suggests that familiar partners may require more explicit or directive feedback to alter their natural speaking patterns. P12 stated *"it's hard to change how we talk because we know each other well"*. This finding points to the need for further investigation into how feedback can be structured to influence speaking balance, particularly in settings where balanced participation is critical for effective collaboration.

Limitations and Rationale for a Follow-Up Study

Methodologically, the study trades experimental completeness for ecological plausibility, prioritising feasibility, user comfort, and iterative design insight over exhaustive factorial control.

Several limitations of Study 1 should be considered when interpreting the findings and planning future research. First, the study's relatively small sample size and the use of familiar dyads may limit the generalisability of the results. Familiarity between participants could have diminished the impact of feedback on certain behaviours, such as speaking balance (H1.4), as pre-existing conversational norms may override subtle cues provided through feedback. Future studies could examine whether the same engagement patterns occur in less familiar or newly formed dyads, where feedback might play a more prominent role in guiding interaction. Second, although feedback mechanisms in both the inter-meeting (C1) and real-time (C2) conditions successfully enhanced awareness of engagement metrics (H1.3/H2.3), they did not produce statistically significant changes in speaking balance (H1.4). This suggests that, unlike other metrics such as interruptions (H1.1/H2.1) and pauses (H1.2/H2.2), speaking balance may require more direct or explicit interventions. Future research could explore feedback designs that specifically prompt equalisation of speaking time, potentially through targeted visualisations or real-time verbal cues.

The limitations of inter-meeting feedback in real-time interaction settings provide a clear rationale for the development of Study 2. In particular, inter-meeting feedback relies on delayed self-reflection, which may be less effective for promoting immediate

behavioural change. Study 2 responds to this limitation by implementing automated real-time feedback to support in-the-moment conversational adjustments. It also addresses a key concern raised in the literature and in Study 1's qualitative responses - namely, that real-time feedback must balance informativeness with emotional comfort, as excessive feedback can cause stress or disengagement. Additionally, participants' reflections revealed that shared conversational history and mutual familiarity often led one participant to dominate speaking time, regardless of feedback. This confounding influence may have obscured effects on speaking balance (H1.4), pointing to the need for more neutral or evenly distributed topics in future studies. Study 2 builds on these insights by incorporating automated metrics, user-informed visualisations, and topic selection techniques that better support balanced engagement and lower user stress.

4.5 Study 2: Refining Real-Time Feedback Mechanisms: Using Automated Engagement Metrics to Elevate Communication Satisfaction and Foster Behaviour Change in Dyadic Video-Based Meetings

Building on insights gained from Study 1, this follow-up study focuses on enhancing real-time feedback mechanisms in dyadic video-based meetings. Its aim is to explore how automated and minimally intrusive designs can foster increased conversational awareness without generating undue stress or disrupting the natural flow of interaction. This study builds on the Wizard-of-Oz design in Study 1 by developing an automated, deployable version of real-time feedback informed by user reactions and design input. Unlike prior systems, this approach integrates subtle visualisations and participant-led feedback preferences to improve user comfort and reduce stress. It also addresses the core challenge of balancing real-time awareness with spontaneity - a major gap in earlier feedback systems.

4.5.1 Research Questions

Study 2 expands upon Study 1's findings by investigating how visualisation techniques, timing, and automation might best support participant engagement. In particular:

- **Q1:** How can real-time feedback mechanisms be designed to heighten behavioural awareness while remaining minimally disruptive in dyadic video-based interactions?
- **Q2:** Which visualisation approaches (i.e. sliding notifications, colour-coded signals, race-track displays) most effectively balance communication satisfaction, self-regulation, and conversational fluidity?

Whereas Study 1 primarily compared inter-meeting vs. combined inter-meeting and real-time feedback, Study 2 seeks to refine the real-time element itself, ensuring that immediacy does not overshadow users' comfort or conversational flow. Few existing systems offer automated, minimally intrusive feedback mechanisms that have been iteratively developed and tested with user input. This study addresses this gap by refining real-time feedback designs grounded in participant preferences. Additionally, Study 2 aims to produce significant improvements across all engagement metrics, including speaking balance - an outcome that did not reach statistical significance in Study 1, likely due to limitations in the type of collaborative task, feedback's immediacy and delivery. By enhancing the visualisation method and automating delivery, Study 2 tests whether a more responsive and user-aligned system can better support balanced participation.

4.5.2 Study Design and Methodology

Participants and Recruitment

A total of 40 participants (forming 20 dyads) took part. Of these, 10 dyads had previously taken part in Study 1 and returned for Study 2 - five originally in the C1 inter-meeting-only condition and five in the C2 inter-meeting + real-time condition - while the remaining 10 dyads were newly recruited for this study. Including returning participants offered an opportunity to assess how prior familiarity with engagement metrics and feedback mechanisms might influence the adoption, perception, and behavioural response to the refined real-time feedback system. This also enabled comparison between first-time and experienced users of conversational feedback.

All participants completed a brief pre-study questionnaire gathering demographic information and personality traits, as listed in Appendix B.3.1. While personality traits were not analysed quantitatively, they informed qualitative interpretation, particularly in understanding individual differences in participants' reactions to feedback. Returning participants had already provided these details in Study 1 but were asked to confirm that their information had not changed. The newly recruited dyads were drawn from a similar participant pool, ensuring diversity in participants' backgrounds and in their comfort with video-based communication.

Ethical approval for this study was covered under the same application as Study 1 (ERGO ID: 82068). Participants provided informed consent, and the Participant Information Sheet is available in Appendix B.1

Procedure

Each dyad completed two structured Zoom sessions separated by a short break, along with a brief practice session to familiarise participants with the feedback dashboard.

The procedure was designed to reduce the initial overwhelm often experienced when receiving real-time notifications, support natural conversation, and capture changes in satisfaction and stress over time.

- **Initial Meeting (10 minutes):** Participants received a short verbal induction explaining that the study examined communication styles. They then conducted a 10-minute conversation over Zoom without any real-time feedback. This session served as a within-dyad reference point rather than a true experimental baseline, enabling comparison of behaviour before and after exposure to real-time feedback within the same interactional context. This mirrored Study 1's approach. To promote balanced turn-taking and structured dialogue, participants completed a cooperative task (a collaborative role-playing game) rather than a free-form conversation.

- **Break Session (5 minutes):** During the break, participants first completed a modified version of the Interpersonal Communication Satisfaction Inventory (ICSI; Hecht (1978)) (presented in Appendix B.3.2) to reflect on the initial conversation. They were then introduced to the real-time feedback dashboard. A short 3-minute practice session followed, during which they explored sample visual cues (i.e. pop-ups and counters) while engaging in one of the short collaborative tasks ("Catapult to Success"), chosen for its ease of interaction and limited cognitive load during familiarisation. This design decision, informed by stress-related findings in Study 1, aimed to reduce potential disruption by helping participants familiarise with the feedback interface.

- **Second Meeting with Real-Time Feedback (10 minutes):** Participants resumed their conversation on Zoom, now supported by the automated dashboard that displayed live feedback based on speaking balance, pauses, and interruptions. Visual cues included colour-coded sliding notifications and counters, designed to be minimally intrusive. As in the first session, participants completed a collaborative role-playing game to ensure consistency across conditions and to simulate a task-oriented environment.

- **Post-Experiment Survey:** After the second session, participants completed a second ICSI and an open-ended questionnaire exploring their experience of the feedback system, including perceived comfort, stress, and conversational flow. New participants completed the general post-experiment questionnaire (Appendix B.3.4), while returning participants were given an extended version that included comparative reflections on Study 1 (Appendix B.3.3). Both versions included questions on the perceived utility of different visualisations (i.e. pop-ups vs. racetrack) and their overall impact on engagement and usability. As in Study 1, a

Likert-scale section assessed participants' awareness of engagement metrics before and after feedback exposure, encouraging reflection on how their speaking behaviour may have changed.

The collaborative tasks used throughout both sessions in Study 2 were designed as structured role-play scenarios to foster mutual engagement, balanced turn-taking, and natural conversational flow. Role-play activities have long been recognised for their effectiveness in simulating real-world challenges and encouraging teamwork, perspective-taking, and problem-solving (Van Ments, 1983; Yee et al., 2024). These scenarios were deliberately chosen to require cooperation between participants who assumed complementary roles, allowing them to co-construct strategies and decisions in dynamic, narrative-driven environments.

The tasks selected for this study encouraged prioritisation, negotiation, leadership, and problem-solving. Survival and planning scenarios simulated real-world pressures while ensuring participants co-constructed strategies in dynamic, complementary roles. Full descriptions of each game, including participant objectives and fictional constraints, are provided in Appendix B.3.5. Games such as Desert Island Survival promote prioritisation, consensus-building, and resource management, while the Pirate Ship Exercise cultivates leadership and navigational coordination under fictional duress (Pearson, 2024; Dynamics, 2024). The City Planning game introduces sustainability constraints, prompting negotiation between environmental and social priorities (TeamBonding, 2024). In the practice round, Catapult to Success engaged participants in iterative testing and problem-solving under resource limitations (TeamBonding, 2024). Later tasks included scenarios like Zombie Apocalypse and Space Mission, which introduce aspects such as survival planning and technical malfunctions to simulate urgency and demand strategic collaboration (Wildgoose, 2024; Research, 2024).

These role-play tasks were sourced from established team-building resources including SessionLab, TeamBonding, Symonds Research, and Wildgoose, ensuring pedagogical value and real-world applicability. Their use allowed the study to observe how participants negotiated turn-taking and engagement in goal-directed dialogues, reflecting workplace-relevant dynamics under varied conversational pressures.

Apparatus: Framework of In-Meeting Feedback

Study 2 introduced a fully automated real-time feedback system, developed in response to limitations observed in Study 1 and refined through a preliminary focus group.

Automated Feedback Dashboard: Design, Timing and Accuracy (Figure 4.3):

- The dashboard was implemented as a web-based application (hosted on Vercel and Render) and processed speech-based engagement data in real-time using

Socket.IO. Notifications appeared near-instantly when the system detected patterns such as frequent interruptions, extended pauses, or unbalanced speaking time.

- To prioritise immediacy, verbal cues like interruptions or intra-pauses were detected as soon as speech resumed. However, this occasionally led to false positives - for instance, classifying brief interjections like ”mhm” as speech. To improve accuracy, a delay mechanism was introduced: the system waited up to three seconds before confirming whether a vocalisation constituted a speaking session. This accounted for short sounds (up to 1s) and added a brief buffer (2s) to check for follow-up speech. The result was a more reliable feedback mechanism, sacrificing minimal immediacy in favour of clarity.
- This system marked a critical shift from the manually triggered Wizard-of-Oz feedback in Study 1 to a fully deployable, automated framework suitable for real-time use. It was designed for responsiveness and user clarity - two issues that earlier feedback tools often compromised through either latency or intrusive visual presentation.

Visualisation Techniques (Figure 4.4):

- Colour-coding feedback helped distinguish between self- and partner-related actions. Red signified self-directed behaviours (i.e. ”You interrupted!”), prompting self-regulation, while blue indicated actions caused by the partner (i.e. ”You were interrupted!”), aiming to reduce blame or stress. These design choices were grounded in literature showing that red conveys alertness, while blue signals calmness (Williams and Bargh, 2008; Gorn et al., 1997).
- Race-track visualisation depicted each participant’s cumulative speaking time along a fixed-length track (10 minutes). This offered a direct, low-disruption view of speaking balance, highlighting disparities without overt judgment.
- Subtle Animations and Emojis replaced the more cartoonish elements used in Study 1. The shift to simple, emotionally neutral emojis helped reduce defensiveness. This aligns with research suggesting that neutral, abstract cues can soften corrective feedback (Corti and Gillespie, 2016) while still prompting self-reflection.

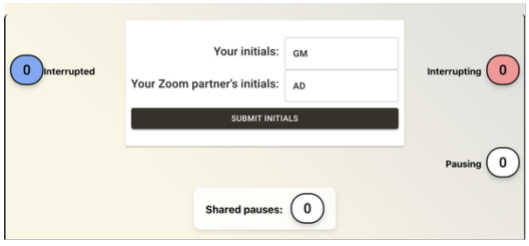

FIGURE 4.3: Participant Login Interface – The initial dashboard screen where participants input their initials to access the feedback system.

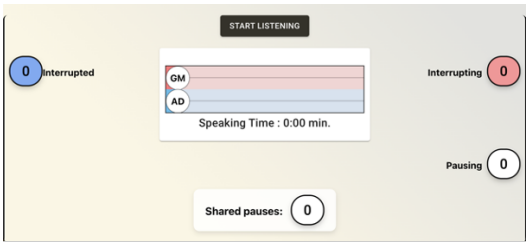

FIGURE 4.4: Race-Track Visualisation Interface – The main feedback dashboard displaying the race-track visualisation, shown after the participant entered their assigned Participant ID to log in. This ID was used to match each participant with their pair and retrieve the appropriate session data from the database.

- The visual feedback approaches included glowing effects in blue (Figure 4.5) or red (Figure 4.6) for emphasis, sliding notifications in red, blue, or white (Figure 4.5, Figure 4.6, Figure 4.7 and Figure 4.8) to gently remind participants of the metrics, counters in the same colour scheme to indicate the frequency of certain behaviours, and a race-track visualisation (Figure 4.9). The race-track visualisation displayed each participant's progress in speaking time during the meeting, providing an intuitive indicator of speaking balance. These techniques aimed to prompt self-reflection rather than explicit behavioural instructions, allowing participants to retain control over their interaction. This approach was informed by research showing that feedback that encourages autonomy and self-regulation fosters more natural conversational adjustments and a sense of agency (Fogg, 2009; Reeves and Nass, 1996).

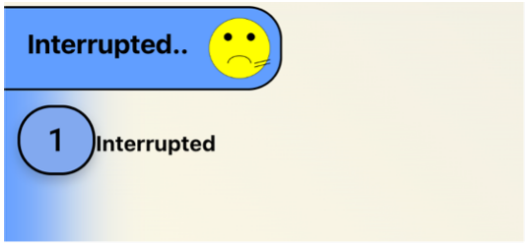

FIGURE 4.5: Blue Notification for Being Interrupted – A visualisation of the blue notification system, including a glowing light, an updated counter, and a sliding notification from the left-hand side, indicating the participant was interrupted.

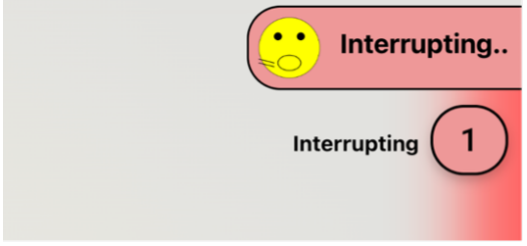

FIGURE 4.6: Red Notification for Interrupting – A visualisation of the red notification system, including a glowing light, an updated counter, and a sliding notification from the right-hand side, indicating the participant interrupted their partner.

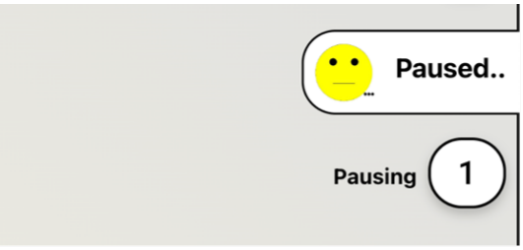

FIGURE 4.7: White Notification for Intra-Pauses – A visualisation of the intra-pause notification system, featuring a white-coloured counter and a sliding notification on the right-hand side of the screen.

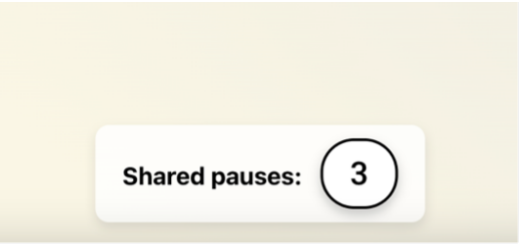

FIGURE 4.8: Inter-Pause Counter – A visualisation of inter-pauses, represented solely by a counter displayed at the bottom of the screen to minimise distraction.

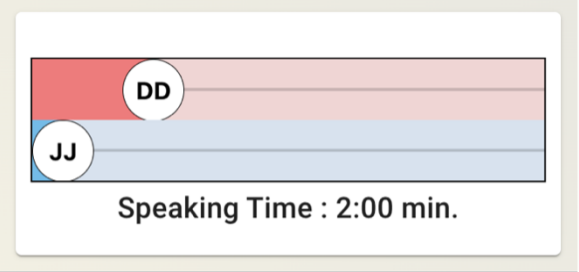

FIGURE 4.9: Race-Track Visualisation for Speaking Balance – A dynamic representation of speaking balance, showing user progress with a ball moving along a race-track based on speaking time. The track is capped at 10 minutes, with the ideal balance being achieved when both participants' balls are centred at the 5-minute mark.

Zoom for Video Interaction:

- As in Study 1, dyads conversed via Zoom. The experimenter monitored passively, letting the automated system handle most real-time notifications.

Implementation of the Automated Real-Time Feedback Tool

The fully automated version of the real-time feedback system for Study 2 was built on top of a React front-end that processes incoming audio and, together with a lightweight Node.js/Express back-end (handling server logic and routing), generates visual notifications about interruptions, pauses, and speaking balance. In contrast to the Wizard-of-Oz approach used in Study 1, all metrics here are now detected automatically, freeing the experimenter from manual triggers and ensuring participants receive immediate, algorithmically derived cues. This section explains the system architecture, the specific technologies used, the data flow from audio capture to front-end visualisations, and how metrics such as interruptions, intra-pauses, and inter-pauses are integrated in a minimally intrusive manner.

The code repository - initially bootstrapped using `Create React App` (a standard scaffolding tool for React projects) - is organised into two main components: a client-side React application and a server-side Node.js application, with Socket.IO enabling

real-time communication. On the client, the application uses the browser's microphone API to capture audio streams, which is fed into an Audio Worklet (a low-level script that allows custom audio processing in real-time) for local volume-based event detection. Meanwhile, the server uses Express for RESTful endpoints, Socket.IO for real-time event broadcasting, and MongoDB (a NoSQL database designed for flexible, document-based storage) for storing participant data. This setup was deployed via Vercel (for the front-end) and Render (for Node), reflecting the goal to provide participants with immediate feedback through minimal-latency connections.

The client side, React-based front-end is responsible for:

- **Audio acquisition and processing:** When participants click "Start Listening", the system requests microphone access. The resulting audio stream is piped into a Web Audio API context, which attaches to the custom volume-processor Audio Worklet. This small script loops through audio samples and computes a root mean square–like "volume" level in near real-time. If the volume crosses a threshold (i.e. 0.04), it is inferred that speech has started. Once the volume remains low for a defined timeout (i.e. 2 seconds), speech is considered to have ended.
- **User session and event logging:** Each participant began by entering a unique participant ID to log into the platform, which enabled the system to match them with their assigned dyad and retrieve any previously saved data from the MongoDB database. Upon logging in, participants also input their preferred two-letter initials, which were then used to visually represent them on the race-track interface (a linear visualisation where each participant's progress is shown as movement along a track). Internally, these initials were linked to a `User` record identified by short name codes. When the local client detected a new `"start"` or `"end"` of speech, it sent a small JSON (JavaScript Object Notation) payload to the `/update-speaking-sessions endpoint`, containing the event type and timestamp. This ensured accurate logging of every speaking session, allowing the system to reconstruct who spoke, when they stopped, and how often these sessions overlapped or resulted in interruptions.
- **Front-end visualisations:** As soon as new data is processed on the server, aggregated metrics are fetched again (i.e. total speaking time, number of intra-pauses, count of interruptions etc.). The React interface maps these metrics to on-screen elements: (a) one race-track representation that moves a participant's coloured initials along a linear path if they accumulate more speaking time; (b) a set of counters for "interrupting" or "interrupted", each displayed with subtle animations or colour-coded text (i.e. red for interrupting, blue for having been interrupted); and (c) sliding or glowing pop-ups for immediate feedback when certain thresholds are crossed (i.e. "Pause detected!"). This emphasis on colour

coding, minimal text, and subtle motion aims to supply participants with real-time awareness without overwhelming them.

On the back-end/server side (Node, Express, and Socket.IO), a simple Express application in `server.js` is in place that listens on a port (default 3000). Although a Socket.IO server was included to allow real-time event broadcasting, the primary mechanism for data transmission during this experiment relied on REST endpoints - HTTP-based interfaces used to send and receive structured data. The relevant server endpoints include:

- `POST /add-user`**:** Creates a new user in MongoDB, storing their chosen name or initials and an initially empty array of speaking sessions;
- `POST /update-speaking-sessions`**:** Appends new speech events to the user's record. The server looks up the partner's record as well, enabling the return of both user and partner session arrays to the client for combined processing;
- `GET /get-speaking-sessions`**:** Retrieves the user's own session data plus the partner's to re-run the engagement metric calculations if needed.

Data is stored using Mongoose models (a schema-based modelling tool for MongoDB). Each User document in the users collection has a speakingSessions array of objects specifying `type, timestamp`, plus a name to uniquely identify that user. This schema is kept intentionally simple to allow dynamic insertion of new speech events.

In Study 2, rather than a Wizard-of-Oz manual observer, the system automatically calculates metrics by reconstructing `"start"` – `"end"` intervals for each user. A helper-function was defined to transform these raw `"start"` and `"end"` events into coherent blocks of speaking time: for instance, if someone started speaking at t = 1000ms and ended at t = 3000ms, that becomes a session [1000,3000]. With two sets of sessions - one for each participant - the code systematically checks:

- **Interruptions:** if participant A's start time occurs while participant B is in a session, "interruptions" are incremented by one;
- **Intra-pauses:** gaps within a single speaker's consecutive sessions if there's a silence longer than two seconds not overlapped by the partner's speech;
- **Inter-pauses:** larger mutual silences where neither participant talks for more than, say, four seconds between transitions of the floor;
- **Speaking balance:** summing the total speaking durations for each participant. The ratio or difference is then used for visual overlays or a "race-track" gauge.

Within the computation file that handles these calculations, this process is performed each time the front-end calls `update-speaking-sessions`, meaning participants see up-to-date counts after each speech event. If the user forcibly stops recording, or if they pause for a long time, the system finalises that session. The final step involves returning fresh metric values back to the front-end, where React triggers new pop-ups or animated counters.

One lesson from Study 1 was that participants found it stressful if a pop-up incorrectly labeled them as interrupting. Therefore a speech-end delay of about 2 seconds is introduced: once the audio volume dips below threshold, the algorithm waits a short grace period before concluding speech has ended. Similarly, for quick ”mhm” or ”uh-huh” backchannels, the algorithm does not mark them as new `"start"` events if they remain short and never exceed the volume threshold for more than a fraction of a second. These small heuristics, along with the user's ability to confirm or stop recording at any time, help limit erroneous notifications, especially false positives. Whenever the client finishes a session (for instance, after the second meeting in the procedure), the function `get-speaking-sessions` is called to compile a final snapshot of all intervals. The corresponding function in charge then merges the user's intervals with those of the partner and calculates final tallies of ”interruptions”, ”pauses”, and ”speaking time”. The server, written in TypeScript, is thus a simple aggregator: it collects data from both participants and returns a combined result, letting the front-end do the majority of the real-time visual updates.

Data Collection

As in Study 1, interruptions, pauses (intra- vs. inter-), and speaking balance were tracked. The difference here was automated detection whenever possible. The experimenter conducted informal spot-checks during sessions to monitor system accuracy and ensure thresholds (i.e. 2-second silence for a meaningful pause) aligned with conversational flow.

Responses to the ICSI were collected twice (mid-experiment and post-experiment) to measure how real-time feedback influenced communication satisfaction over the course of a single session. The post-experiment questionnaire also included a short series of Likert-scale items assessing participants' awareness of engagement metrics (i.e. interruptions, pauses, and balance) before and after receiving feedback, as in Study 1's case. In addition, open-ended questions gave participants space to discuss their experiences of visual and textual cues, or any perceived improvements from Study 1's design.

Data Analysis

Both quantitative and qualitative approaches were used. System logs and manually verified metrics were analysed for significant changes between the first and second

meetings. T-tests or Wilcoxon analyses were conducted, based on the results of Shapiro-Wilk tests for normality. Returning and new participants were also compared to see if prior exposure to engagement metrics shaped their readiness to adopt real-time feedback (i.e. by looking at differences in interruptions or speaking balance). ICSI scores were compared across baseline, mid-experiment, and post-experiment to determine whether participants' sense of conversational satisfaction improved.

In this study, qualitative analysis was used to examine how participants made sense of real-time engagement feedback and its impact on conversational balance and interactional comfort. It was not intended to provide a sequential or micro-analytic account of task interaction, but to capture participants' interpretations of behavioural change and perceived social effects during live interaction. Open-ended responses were explored thematically. Particular attention was paid to how participants described stress or relief when notifications popped up, whether they found race-track visuals useful, and how they experienced the anonymity or privacy aspects (i.e. only seeing their own data, rather than a partner's). The difference between returning and new participants was also noted, highlighting possible carryover from Study 1's feedback experiences.

4.5.3 Results

The study included a total of 40 participants, with ages ranging from 18 to 54 years. The majority of participants (70.5%) fell within the 25–34 age group, comprising 31 individuals. This was followed by 6 participants (13.6%) in the 35–44 age group, 2 participants (4.5%) in the 45–54 age group, and 1 participant (2.3%) in the 18–24 age group. The mean age of the participants was approximately 31.8 years, with a Std. Dev.=5.6 years. In terms of gender distribution, 55.0% of the participants were male (22 individuals), while 45.0% were female (18 individuals). In the next subsections, an analysis and presentation of the hypotheses is provided, focusing on the quantitative data collected during the study. This includes an examination of real tracked behaviour, participants' perceived awareness, as well as the results of the standardised ICSI test.

A. Behaviour/Real Tracked Data

In Study 2, engagement metrics were aggregated, rather than splitting participants into groups such as new participants, returning C1 participants, and returning C2 participants. Here, the focus was on evaluating behavioural changes as a result of one feedback system, rather than its impact on specific subgroups with different feedback approaches, as in Study 1. Aggregating engagement metrics across all dyads enabled a more holistic analysis of how the real-time feedback system influenced behaviour, independent of prior exposure. Table 4.5 presents the descriptive statistics and normality test results for each metric, while Table 4.6 reports the statistical comparisons between first and second meetings.

Furthermore, in contrast to Study 1, where speaking balance was manually decided based on turn-taking patterns (i.e. noting which participant spoke more than the other using a binomial outcome), Study 2 leveraged the automated system's ability to track precise speaking durations in seconds. This allowed for a more granular and continuous measurement of speaking balance, as the system logged each participant's cumulative speaking time throughout the session.

TABLE 4.5: Descriptive Statistics for each Engagement Metric, along with the Shapiro-Wilk test of normality.

Metric	First Meeting					Second Meeting				
	Descriptive Stats			Shapiro-Wilk Normality Test		Descriptive Stats			Shapiro-Wilk Normality Test	
	Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.	Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.
Interruptions	8.2	5.57	0.89	0.889	0.001	4.2	3.86	0.62	0.795	0.000
Intra-pauses	5.65	4.09	0.65	0.815	0.000	2.63	2.32	0.37	0.886	0.000
Inter-pauses	9.7	7.9	1.27	0.806	0.000	5.4	6.15	0.99	0.629	0.000
Speaking balance	137.5	93.79	21.52	0.917	0.088	34.6	20.54	4.71	0.946	0.317

TABLE 4.6: Comparison of Interruptions, Intra-Pauses, and Inter-Pauses Between First and Second Meetings for all participants in C1. This table includes the statistical test outcomes (T-Test or Wilcoxon Test) including the test statistic values and p-values. Results highlight significant changes in interaction metrics, emphasising differences in participant behaviour across the two meetings.

Metric	Interruptions	Intra-pauses	Inter-pauses	Speaking balance
p-value	0.000	0.000	0.000	0.000
t-value/Wilcoxon Statistic	0.0 (Wilcoxon)	4.0 (Wilcoxon)	0.0 (Wilcoxon)	4.614 (t-value)
Mean-difference	4.0	3.02	4.3	102.9

H1.1: There is a statistically significant difference in the number of interruptions between Meeting 1 and Meeting 2.

The results indicate a highly significant difference in the number of interruptions between Meeting 1 (Mean = 8.20, Std. Dev. = 5.57) and Meeting 2 (Mean = 4.20, Std. Dev. = 3.86), with fewer interruptions observed in Meeting 2 (W = 0.0, p = 1.04e-07, $p < 0.05$). Therefore, H1.1 is accepted, confirming that participants' interruption frequency significantly decreased between the two meetings.

H1.2: There is a statistically significant difference in the number of intra-pauses between Meeting 1 and Meeting 2.

A highly significant difference was found in the number of intra-pauses between Meeting 1 (Mean = 5.65, Std. Dev. = 4.09) and Meeting 2 (Mean = 2.63, Std. Dev. = 2.32), with participants pausing less frequently in Meeting 2 (W = 4.0, p = 1.99e-07, $p < 0.05$). H1.2 is accepted, supporting the hypothesis that participants significantly reduced intra-pauses between meetings.

H1.3: There is a statistically significant difference in the number of inter-pauses between Meeting 1 and Meeting 2.

The analysis revealed a highly significant difference in the number of inter-pauses between Meeting 1 (Mean = 9.70, Std. Dev. = 7.90) and Meeting 2 (Mean = 5.40, Std. Dev. = 6.15), with fewer inter-pauses occurring in Meeting 2 (W = 0.0, p = 1.53e-07, $p < 0.05$). Thus, H1.3 is accepted, indicating that participants significantly reduced inter-pauses between the two meetings.

H1.4: There is a statistically significant difference in the balance of speaking time between participants in Meeting 1 and Meeting 2.

A highly significant difference was found in the balance of speaking time between participants in Meeting 1 (Mean = 137.5 seconds, Std. Dev. = 93.79 seconds) and Meeting 2 (Mean = 34.6 seconds, Std. Dev. = 20.54 seconds), with speaking time balance improving in Meeting 2 (t = 4.614, p = 0.00019, $p < 0.05$). H1.4 is accepted, confirming that participants achieved a significantly better balance in speaking time during the second meeting.

B. Perceptions: Likert Scales - Awareness of Engagement Metrics Pre and Post Feedback

For this analysis, as opposed to Study 1's approach, participants were divided into "new" and "returning" categories. This distinction was necessary because returning participants had already been exposed to engagement metrics during Study 1, giving them an initial baseline of awareness. By splitting these groups, it was possible to differentiate between the learning curve of new participants, who were encountering the metrics for the first time, and the returning participants, whose awareness might reflect cumulative experiences across both studies (Table 4.7 and Table 4.8). Feedback type (C1 vs. C2) was irrelevant for this analysis since the primary goal was to assess changes in awareness levels, not to compare the impact of different feedback types. This grouping also enabled direct comparison of awareness between new and returning participants, providing deeper insights into the role of prior exposure to engagement metrics (Table 4.9).

TABLE 4.7: Descriptive statistics and Shapiro-Wilk normality test results for awareness of engagement metrics in the first and second meetings, where Likert scale responses were transformed into scores ranging from 1 (Not at all aware) to 5 (Extremely aware).

Participants	Metric	Before Feedback					After Feedback				
		Descriptive Stats			Shapiro-Wilk Normality Test		Descriptive Stats			Shapiro-Wilk Normality Test	
		Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.	Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.
New	Interruptions	1.35	0.88	0.2	0.456	0.000	4.7	0.8	0.18	0.441	0.000
	Pauses	1.55	1.23	0.28	0.508	0.000	4.7	0.66	0.15	0.515	0.000
	Speaking balance	1.35	0.75	0.17	0.506	0.000	4.7	0.66	0.15	0.515	0.000
Returning	Interruptions	2.75	1.07	0.24	0.920	0.098	4.95	0.22	0.05	0.236	0.000
	Pauses	2.4	1.14	0.26	0.849	0.005	4.8	0.41	0.09	0.495	0.000
	Speaking balance	2.35	1.04	0.23	0.881	0.018	4.85	0.49	0.11	0.354	0.000

TABLE 4.8: Paired t-test results comparing awareness of engagement metrics between the first and second meetings: for new and returning participants.

Participants	**New**			**Returning**		
Metric	Interruptions	Pauses	Speaking balance	Interruptions	Pauses	Speaking balance
p-value	0.000	0.000	0.000	0.0001	0.0002	0.0001
Wilcoxon Statistic	1.0	3.5	0.0	0.0	0.0	0.0
Mean-difference	-3.35	-3.15	-3.35	-2.20	-2.4	-2.5

TABLE 4.9: Mann-Whitney U-test results comparing awareness of engagement metrics between the new participants and returning participants across the engagement metrics.

Metric	**Interruptions**	**Pauses**	**Speaking balance**
p-value	0.000	0.000	0.000
U Statistic	1.0	3.5	0.0

H2.1: New participants' awareness of interruptions is significantly higher after receiving real-time feedback compared to before.

The analysis shows a significant increase in new participants' awareness of interruptions after receiving real-time feedback, with awareness increasing from before (Mean = 1.35, Std. Dev. = 0.88) to after (Mean = 4.70, Std. Dev. = 0.80) (W = 1.0, p = 4.17e-05, p ¡ 0.05). Therefore, H2.1 is accepted, confirming that real-time feedback effectively improved participants' awareness of interruptions.

H2.2: New participants' awareness of pauses is significantly higher after receiving real-time feedback compared to before.

A significant improvement in new participants' awareness of pauses was observed, increasing from before (Mean = 1.55, Std. Dev. = 1.23) to after (Mean = 4.70, Std. Dev. = 0.66) (W = 3.5, p = 7.32e-05, $p < 0.05$). H2.2 is accepted, indicating that real-time feedback significantly enhanced awareness of pauses.

H2.3: New participants' awareness of speaking time distribution is significantly higher after receiving real-time feedback compared to before.

The results demonstrate a significant increase in new participants' awareness of speaking time distribution after receiving real-time feedback, with awareness improving from before (Mean = 1.35, Std. Dev. = 0.75) to after (Mean = 4.70, Std. Dev. = 0.66) (W = 0.0, p = 4.79e-05, p ¡ 0.05). H2.3 is accepted, supporting the conclusion that real-time feedback is effective in raising participants' awareness of speaking time distribution.

H2.4: Returning participants' awareness of interruptions is significantly higher after receiving real-time feedback compared to before.

For returning participants, awareness of interruptions significantly increased after receiving real-time feedback, from before (Mean = 2.75, Std. Dev. = 1.07) to after (Mean = 4.95, Std. Dev. = 0.22) (W = 0.0, p = 0.0001, $p < 0.05$). H2.4 is accepted, confirming the effectiveness of feedback in improving awareness for this metric.

H2.5: Returning participants' awareness of pauses is significantly higher after receiving real-time feedback compared to before.

Returning participants' awareness of pauses significantly increased after receiving real-time feedback, from before (Mean = 2.40, Std. Dev. = 1.14) to after (Mean = 4.80, Std. Dev. = 0.41) (W = 0.0, p = 0.0002, $p < 0.05$). H2.5 is accepted, supporting the hypothesis that real-time feedback enhances awareness of pauses for returning participants.

H2.6: Returning participants' awareness of speaking time distribution is significantly higher after receiving real-time feedback compared to before.

The analysis confirms a significant increase in returning participants' awareness of speaking time distribution after real-time feedback, from before (Mean = 2.35, Std. Dev. = 1.04) to after (Mean = 4.85, Std. Dev. = 0.49) (W = 0.0, p = 0.0001, $p < 0.05$). H2.6 is accepted, indicating the effectiveness of real-time feedback in improving this metric for returning participants.

To better understand how prior exposure to engagement feedback influenced participants' baseline awareness, three more hypotheses were formulated to compare self-reported engagement awareness before any feedback was received in Study 2. This comparison was made strictly between returning participants (who had taken part in Study 1) and new participants (with no prior experience of the system or feedback metrics). While post-experiment comparisons focused on how awareness changed as a result of feedback exposure, this pre-feedback analysis was intended to test whether participants entering the study with previous feedback experience were already more attentive to conversational behaviours.

H3.1: There is a significant difference in interruptions awareness between returning participants and new participants before the experiment.

The analysis revealed a significant difference in interruptions awareness between returning participants and new participants before the experiment (U = 342.0, p = 0.000044, $p < 0.05$). This suggests that returning participants had a notably different level of awareness of interruptions compared to new participants prior to the experiment. Therefore, H3.1 is accepted.

H3.2: There is a significant difference in pauses awareness between returning participants and new participants before the experiment.

A significant difference in pauses awareness was found between returning participants and new participants before the experiment (U = 296.5, p = 0.004656, $p < 0.05$). This indicates that returning participants had a distinct level of awareness of pauses compared to new participants before starting the experiment. H3.2 is accepted.

H3.3: There is a significant difference in speaking time awareness between returning participants and new participants before the experiment.

The results show a significant difference in speaking time awareness between returning participants and new participants before the experiment (U = 310.0, p = 0.001219, $p < 0.05$). This confirms that the two groups had differing levels of awareness of speaking time distribution prior to the experiment. Therefore, H3.3 is accepted.

C. Perceptions: Likert Scales - Standardised ICSI test

For the ICSI test, all participants' results were analysed as a single group, rather than splitting them into subcategories (Table 4.10 and Table 4.11). This decision was based on the standardised nature of the ICSI, which measures overall communication satisfaction. Since the test was designed to capture a universal perspective on communication quality, regardless of participant type, analysing the results collectively provided a broader understanding of how feedback influenced satisfaction levels. Moreover, this approach avoided over-complicating the analysis and allowed for more straightforward comparisons between satisfaction before and after receiving feedback.

TABLE 4.10: Descriptive statistics and Shapiro-Wilk normality test results for the ICSI standardised test conducted before and after participants received feedback. Responses were measured on a 7-point Likert scale, with scores ranging from 1 (Strongly Disagree) to 7 (Strongly Agree).

ICSI Score	Before Feedback					After Feedback				
	Descriptive Stats			Shapiro-Wilk Normality Test		Descriptive Stats			Shapiro-Wilk Normality Test	
	Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.	Mean	Std. Dev.	Std. Err. Mean	Statistic	Sig.
	75.30	20.51	3.24	0.913	0.004	108.83	8.40	1.33	0.932	0.019

TABLE 4.11: Wilcoxon signed-rank test results for the ICSI standardised test. The table evaluates whether there were significant differences in participants' communication satisfaction levels, as measured on a 7-point Likert scale before and after feedback.

Variable	Value
p-value	0.000
Wilcoxon Statistic	29.0
Mean Difference	-33.53

H4: There is a significant difference in communication satisfaction scores before and after receiving real-time feedback.

The analysis shows a significant increase in communication satisfaction scores after participants received real-time feedback. The mean score increased from before (Mean = 75.30, Std. Dev. = 20.51) to after (Mean = 108.83, Std. Dev. = 8.40), indicating a substantial improvement in perceived communication quality. The data were not normally distributed as per the Shapiro-Wilk test (Statistic = 0.913, p = 0.0048 before; Statistic = 0.932, p = 0.0191 after). The Wilcoxon Signed-Rank test confirmed the difference was statistically significant (W = 29.0, p = 3.16e-9, $p < 0.05$). Therefore, H4 is accepted, demonstrating that real-time feedback significantly improved communication satisfaction scores.

4.5.4 Discussion

Within the triangular state framework, these results indicate that interactional balance can be actively stabilised during live interaction when feedback is subtle and user-controlled.

Engagement Metrics

The analysis revealed significant improvements in participant behaviour across all engagement metrics between the first and second meetings. For interruptions (H1.1), there was a notable reduction following the introduction of refined real-time feedback. Additionally, while certain metrics, like interruptions and inter-pauses, retained significance as observed in Study 1, this follow-up experiment demonstrated significant improvements across all metrics, including intra-pauses and speaking balance, marking a substantial advancement over the manually triggered feedback in Study 1 and a departure from intrusive real-time systems in prior work. By automating engagement feedback while prioritising user comfort and interpretability, the system presented in Study 2 demonstrates a scalable alternative to manual or intrusive systems. This approach marks a significant contribution to the design of responsive communication tools. Significant reductions in both individual (H1.2) and inter-pauses (H1.3) further suggest that participants adapted their turn-taking strategies, resulting in fewer disruptions and smoother conversational flow. This aligns with contemporary perspectives on engagement in CMC, which argue that non-intrusive feedback mechanisms can create a more balanced interaction by addressing both self-awareness and mutual conversational dynamics (Terry and Cain, 2016; Kiesler et al., 2000). Moreover, the significant improvement in speaking balance (H1.4) demonstrates the effectiveness of the race-track visualisation in creating a more equitable distribution of speaking time. Unlike earlier tools that offered prescriptive solutions, this feedback mechanism enabled participants to self-regulate and adjust their speaking behaviours autonomously. The novelty of this approach lies in its focus on empowering participants rather than controlling their behaviours, a departure from directive feedback approaches often critiqued in HCI literature for being overly intrusive (DeSanctis and Monge, 1999).

Awareness Perceptions

The awareness likert scales highlighted significant improvements in participants' self-awareness of interruptions, pauses, and speaking balance after real-time feedback was introduced (H2.1–H2.6). These findings are consistent across both new and returning participants, with significant increases in awareness reported in all metrics. Notably, the differences between new and returning participants' pre-experiment awareness levels (H3.1–H3.3) further validate the role of prior exposure to feedback in shaping engagement perceptions. Even though these results coincide with the results from Study 1, they underline the importance of structured feedback mechanisms in enhancing conversational awareness. Studies by Gudykunst and Nishida (1994) and Bailenson et al. (2008) have demonstrated that greater self-awareness of conversational dynamics leads to improved interaction quality. However, this study advances this understanding by operationalising awareness through real-time notifications that balance subtlety with informativeness. This novel approach directly addresses concerns raised in prior studies about the stress-inducing nature of intrusive feedback (Nadler, 2020) and provides one of the first empirical demonstrations that participant-informed design can preserve spontaneity while still improving engagement awareness.

Moreover, the comparisons between new and returning participants' pre-feedback scores (H3.1–H3.3) revealed significant differences across all three engagement metrics, indicating that those who had previously taken part in Study 1 entered the session with a measurably greater awareness of their own conversational behaviours. This supports the claim that structured feedback - even when received in a prior context - can have lasting cognitive effects on how individuals perceive and self-monitor engagement cues. These findings also reinforce the argument that feedback interventions do not need to be continuous to be effective; but they can rather foster durable shifts in communication habits that persist over time. As such, the results offer further empirical support for the cumulative value of repeated exposure to engagement feedback, a principle that future systems could leverage to reinforce positive communication behaviours without requiring constant intervention.

Communication Satisfaction (ICSI Test)

The highly significant improvement in communication satisfaction scores (H4) underscores the value of the refined feedback mechanisms. The increase from a mean score of 75.30 to 108.83 indicates that participants perceived the feedback as both useful and engaging. These findings align with prior studies highlighting the correlation between communication satisfaction and engagement in virtual settings (Gunawardena, 1995; Picciano, 2002). The novelty of this study lies in its application of the modified ICSI questionnaire to capture dimensions of communication satisfaction, such as natural engagement and freedom of expression. This approach goes beyond traditional measures by capturing how users felt about their expressive freedom and comfort under

real-time conditions - directly responding to earlier concerns around feedback being overly controlling or distracting.

By incorporating these dimensions, the study provides a more comprehensive understanding of how feedback impacts user satisfaction in real-time interactions. Furthermore, the correlation between mid- and post-experiment ICSI scores enables an exploration of longitudinal trends in communication satisfaction, a methodological advancement over previous studies.

Perceptions of Experience and Differences Between New and Returning Participants

Qualitative responses here were also examined using RTA, with meaning understood as co-constructed through participant accounts and researcher interpretation. Similar to the previous study, this analysis was not designed to provide a turn-by-turn reconstruction of task interaction, but to explain how participants interpreted engagement, feedback, and conversational balance under real-time conditions.

Themes occuring within new participants: positive reception and awareness:

- **Theme 1: Positive Reception Despite Initial Hesitation** - New participants initially expressed curiosity mixed with concern about real-time feedback. However, as they progressed, many reported valuing the system for increasing awareness of conversational dynamics. For instance, participants like P23 described being *"nervous"* initially but later noted how the feedback enhanced self-awareness. This aligns with research on the acceptance of novel technologies, where users' initial skepticism often transitions into appreciation as they observe tangible benefits (Davis, 1989; Venkatesh et al., 2003). The feedback's ability to transform hesitation into a learning opportunity showcases the strength of the system's design. P28 stated *"I started noticing how much I was talking, and it made me slow down a bit"*, demonstrating that participants quickly adapted and used the feedback constructively. The novelty here lies in the system's ability to foster immediate behavioural adjustment without overwhelming first-time users.
- **Theme 2: Heightened Awareness of Self and Partner** - New participants also highlighted how the system increased awareness of both their own and their partner's behaviours. P25 reflected *"I didn't realise how much I interrupted until the system pointed it out"*. This mirrors findings from Sharma et al. (2020), which suggest that real-time, actionable feedback can facilitate a dual awareness of individual and collective interaction patterns. From a contextual perspective, this pattern aligns with SIPT's account (Walther, 1996) of why cue loss heightens the social salience of engagement signals. However, the behavioural adjustments observed here are better explained through self-regulation under Cognitive Load. However, the immediate behavioural adjustments reported by participants are

better explained through a cognitive load and self-regulation lens, whereby externalising interaction metrics reduces the need for continuous self-monitoring during live conversation. In this case, real-time visual feedback provided participants with a supplementary channel for understanding interaction dynamics, enabling them to build awareness and coordination despite the limitations of video-mediated settings. Unlike inter-meeting feedback, real-time notifications enabled new participants to make on-the-spot adjustments, a critical advantage for dynamic, task-oriented conversations.

Themes occuring within returning participants from Study 1, C1:

- **Theme 3: Reflective Awareness of Contribution Patterns** - Returning participants from C1, accustomed to inter-meeting feedback, noted the immediacy of real-time feedback as transformative. P34 remarked *"It made me think about my behaviour while it was happening"*. This reflects the transition from reflective to reflexive awareness - moving from post-interaction adjustments to real-time self-regulation (Sarker et al., 2012). The immediacy allowed participants to adapt dynamically, a critical improvement over out-of-meeting feedback. The system's ability to encourage such shifts highlights its novelty in providing actionable insights during live interactions.
- **Theme 4: Stress as a Transitional Tool** - While some participants reported initial stress with real-time feedback, many reframed it positively. P21 stated *"It felt like I was being watched, but I realised it was helping me become more aware"*. This aligns with research suggesting that moderate stress can enhance learning and self-regulation when paired with supportive tools (Kan et al., 2021). The study's refined design ensured that stress was not a destabiliser but rather a motivator for improvement, a marked departure from the stress-inducing feedback of earlier designs.

Themes occuring within returning participants from Study 1, C2:

- **Theme 5: Relief from Stress** - Participants previously exposed to stress-inducing feedback (Condition 2) appreciated the less intrusive nature of the new system. P29 commented *"It made me more conscious without making me feel anxious"*. This shift demonstrates the effectiveness of incorporating user preferences from focus groups, such as using neutral visual cues and emojis, which research has shown to reduce cognitive load and perceived judgment (Kay et al., 2013).
- **Theme 6: Positive Shift in Perception of Feedback** - These participants noted that the revised feedback felt more supportive. P34 highlighted *"It didn't feel like it was constantly correcting me, but rather guiding me"*. This underscores the

value of designing feedback systems that foster collaboration rather than control (Hattie and Timperley, 2007). The system's less intrusive yet informative nature represents a significant improvement, addressing the criticism of earlier feedback mechanisms.

Themes occuring in regards to stress and relief in real-time feedback:

- **Theme 7: Balancing Both Sides of the Story** - A unique feature of the system was its ability to highlight mutual conversational dynamics. Participants like P27 found relief in seeing that interruptions were not one-sided: *"The feedback made me see it wasn't just me"*. This balanced framing aligns with theories of shared accountability in communication, which suggest that acknowledging mutual contributions can reduce defensiveness and promote cooperative behaviour (Clark and Brennan, 1991).
- **Theme 8: Stress as a Tool for Improvement** - While some stress persisted, participants increasingly viewed it as constructive. P26 noted *"It was a bit stressful, but in a good way. It pushed me to think before speaking"*. This shift aligns with Yerkes-Dodson's Law, which suggests that moderate stress can enhance performance in complex tasks (Teigen, 1994). The ability to repurpose stress as a motivator marks a significant improvement from earlier systems that induced counterproductive anxiety.

Themes occuring in regards to challenges with partner contributions:

- **Theme 9: Struggle with Partner Dominance** - Some participants faced challenges unrelated to the feedback system, such as dominant partners limiting their contributions. P19 shared *"I didn't feel as engaged because [my partner] was doing most of the talking"*. This highlights the limitations of feedback systems in addressing interpersonal dynamics, particularly when one participant's personality or communication style dominates.

Future work could explore more adaptive feedback strategies that detect conversational imbalance not only through speech metrics, but also through partner responsiveness - adding a richer layer to future systems aiming to support equitable participation.

4.6 General Discussion

4.6.1 Synthesis of Findings

This research demonstrates, for the first time, how structured engagement metrics - interruptions, pauses, and speaking balance - can be operationalised into real-time feedback mechanisms that are both effective and minimally disruptive in video-based dyadic communication. By combining Wizard-of-Oz and automated systems, the studies reveal that conversational behaviours can be gently influenced through subtle, user-tested visualisations that encourage self-awareness and self-regulation. Unlike prior systems that relied on avatars, chatbots, or post-hoc summaries (i.e. Bailenson et al. (2008); Følstad and Skjuve (2019)), or those which introduced stress via intrusive prompts (Liang et al., 2022), this work advances a design-led alternative that balances immediacy, accuracy, and user comfort. Rather than replicating non-verbal gestures through artificial embodiments, this approach supports users directly in managing engagement through transparent, data-driven cues. From the perspective of the triangular state framework, these findings demonstrate how real-time feedback can stabilise interactional balance in familiar dyads, complementing the trust-oriented interventions explored in Chapter 3. Across both studies, qualitative analysis was used to explain how behavioural changes were experienced and interpreted by participants, rather than to analyse the micro-structure of task interaction itself.

Study 1 demonstrated that inter-meeting feedback was effective in raising participants' awareness of their conversational patterns over time. However, it fell short in enabling immediate adjustments during the interaction itself. The quantitative results from Study 2 validated the potential of refined real-time feedback in improving all engagement metrics. Unlike Study 1, which did not show significant improvements in speaking balance and intra or inter pauses, Study 2 showed marked increases in turn-taking awareness and reductions in interruptions.

A key insight concerns the tension between feedback immediacy and user comfort. When delivered subtly, real-time feedback can shift participant awareness without disrupting conversational spontaneity. While real-time feedback induced stress in some cases, its revised delivery in Study 2 promoted self-reflection rather than correction - transforming stress from a negative pressure into a constructive awareness signal. The system was designed to reduce extraneous cognitive load by presenting emotionally neutral, visually minimal feedback and avoiding interruptive alerts. This aligns with Cognitive Load Theory (van Bruggen et al., 2002), which differentiates between intrinsic task demands and extraneous load introduced by the environment. In this case, the visualisations reduced the environmental burden on users' cognitive resources, allowing them to focus more fully on the conversation itself. Participants reported heightened understanding of their own interaction styles and made real-time adjustments - an

effect that would not be possible without computationally delivered feedback. Unlike face-to-face conversations, where imbalances may go unnoticed, the system introduced here offers a structured, real-time loop that enhances communication as it unfolds. Qualitative data indicated that participants experienced neutral and non-judgmental visual feedback as receptive and controllable. Collectively, these findings demonstrate that real-time feedback, when thoughtfully designed, can improve engagement and satisfaction without disrupting the natural flow of conversation. Instead, these findings are best explained through a Cognitive Load and self-regulation lens, whereby externalising interaction metrics reduces monitoring demands while neutral, non-evaluative presentation preserves participant comfort and autonomy during live interaction.

These findings should not be interpreted as validating SIPT as a mechanism for real-time behavioural change. Rather, SIPT explains why misaligned cues matter, while the observed effects arise from reduced monitoring demands and supported self-regulation.

4.6.2 Implications for the Design of Automated Engagement Feedback Mechanisms

The practical implications of this research are directly relevant to the design of communication platforms, particularly those aimed at facilitating virtual team collaboration. Feedback mechanisms, when integrated thoughtfully, can enhance participation, foster equitable contributions, and improve conversational flow.

Unlike earlier tools that relied on replicating non-visible cues through avatars or gaze-based proxies (i.e. (Bailenson et al., 2008; Vertegaal et al., 2001)), or presented speaking metrics via static or cluttered dashboards (Verbert et al., 2020), this system takes a different approach. Prior systems often showed promise in increasing awareness but lacked sustained adoption, in part due to their intrusiveness or cognitive burden (Liang et al., 2022). While these efforts demonstrated that real-time feedback can influence interaction, they struggled to balance responsiveness with user comfort.

This research builds on that foundation by introducing a system that is the first to combine design-led visualisations (i.e. race-track, colour-coded pop-ups) with automated engagement metric detection - grounded in user co-design and focus group testing. Rather than instructing users or attempting to mimic social cues, this approach empowers users to self-correct by surfacing interaction patterns in subtle, emotionally neutral ways. It represents a shift from moderator-style interventions to ambient, autonomy-preserving cues.

Based on participants' reactions and system performance, four core principles are proposed to guide the design of future real-time engagement feedback systems:

1. **Non-Disruptive Participation:** Feedback should be delivered via subtle, minimally-intrusive cues that preserve conversational flow. This study's findings showed that participants responded better to gentle visual indicators than to explicit prompts.
2. **Customisation and Adaptability:** Participants expressed a desire to tailor feedback to their needs - such as toggling metrics on/off or adjusting feedback timing. This echoes prior HCI research advocating for flexible user interfaces that accommodate individual preferences (Norman, 2013).
3. **Multi-Party Functionality:** Future systems should be extended to group settings, where dynamics are more complex. Feedback for multi-user interactions could aid in managing turn-taking and airtime distribution - crucial in professional and educational scenarios (Sun and Zhang, 2006).
4. **Supportive Tone in Feedback Delivery:** Framing feedback as collaborative suggestions rather than corrective judgments enhances user receptiveness. Participants in these two studies appreciated emotionally neutral feedback that encouraged reflection without inducing stress (Heath and Heath, 2017).

4.6.3 Empirical and Methodological Contributions

This chapter introduces a real-time feedback system grounded in conversational metrics and lightweight interface design. Key contributions include:

- **Operationalising core engagement metrics** into a unified, computable system;
- **Designing for subtlety and user autonomy** through non-intrusive visual feedback;
- **Empirically validating the system** across both inter-meeting and in-meeting contexts.

These contributions are discussed in greater depth throughout the remainder of this section.

Methodologically, this work introduces a novel Wizard-of-Oz + automation pipeline for real-time feedback prototyping, allowing early-stage systems to be tested and iterated before full deployment. Empirically, it is the first to quantify behavioural change, metric-specific awareness, and satisfaction across both inter-meeting and in-meeting, real-time interventions in a dyadic video communication setting. Rather than introducing new theoretical constructs, this study empirically tests how structured feedback mechanisms operate under the foregrounded psychological constraints of Cognitive Load and self-regulation. Beyond theoretical validation, this research advances

methodological approaches by operationalising engagement metrics into a structured, real-time feedback system. The empirical findings show how real-time visual feedback can modulate conversational behaviour while maintaining low extraneous cognitive load and preserving interactional comfort, offering practical design insights for future CMC tools.

Additionally, the study contributes to a growing understanding of stress as a dual-edged factor in feedback design. While prior research (i.e. Bickmore and Cassell (2001)) has framed stress primarily as a barrier to effective communication, this work empirically supports the Yerkes-Dodson Law (Teigen, 1994) by demonstrating that moderate, well-framed stress can motivate positive behavioural adjustment. Although formal stress measurements were not used, qualitative feedback consistently indicated that participants found the experience stimulating rather than overwhelming - particularly in the refined system of Study 2. This suggests that feedback systems should carefully balance informativeness and subtlety to maintain user engagement without creating anxiety.

Finally, this work explores the interplay between personality traits and feedback perception. While personality data were collected via a short-form Big Five inventory, the study focused primarily on behavioural outcomes and user experience, with personality traits used to contextualise participant profiles rather than serve as an independent variable. Nonetheless, personality differences emerged in qualitative reflections - for example, more introverted participants often favoured softer, suggestion-based cues, while more assertive, or extroverted individuals preferred direct prompts. These insights suggest a promising direction for future work: developing adaptive feedback systems tailored to user traits in video-mediated settings.

This research contributes to the broader HCI and CMC landscape by offering a structured, minimally invasive system deployable in real-time, task-based conversations. Unlike many previous studies that focused solely on awareness or post-hoc reflection (i.e. DiMicco et al. (2004); Bailenson (2021)), this work demonstrates tangible behavioural change and improved satisfaction during live interaction. It situates itself at the intersection of engagement modelling, adaptive interface design, and conversational user experience - offering a replicable and scalable model for improving online communication.

4.6.4 Future Research Directions

The findings from this research pave the way for future investigations aimed at refining feedback systems, particularly in terms of automation and computational scaling.

- **Scope constraints and familiarity-dependent evaluation:** The engagement feedback system was evaluated exclusively with familiar dyads in order to minimise variability associated with first-contact uncertainty, inhibition, and rapid relationship formation. While this design choice strengthens internal validity for assessing self-regulation under cognitive load, it constrains inference about how such feedback might operate during early relationship formation. Evaluating engagement feedback in unfamiliar dyads would introduce additional confounds related to social caution and evolving conversational norms, and is therefore treated as future work rather than a baseline condition in the present feasibility-focused study.

- **Balancing immediacy and accuracy:** A significant challenge highlighted in Study 2 was the trade-off between providing immediate feedback and ensuring its accuracy. Future research could explore ways to optimise this balance further by integrating machine learning algorithms capable of classifying speech events in real-time with greater precision. For example, advanced natural language processing (NLP) models could be trained to recognise not only the frequency and duration of speech but also its contextual meaning and intent, enabling differentiation between meaningful speech and filler sounds. Such advancements could ensure that immediate feedback remains both accurate and non-disruptive, enhancing the user experience in real-time feedback systems.

- **Automating engagement metric detection at scale:** While Study 2 demonstrated a fully automated real-time feedback system, its scalability remains an open question. Future research should focus on developing computationally efficient models that can automate engagement metric detection in large-scale, real-world virtual meetings. Current implementations rely on controlled environments, but integrating feedback mechanisms into high-traffic platforms (i.e. Zoom, Microsoft Teams) would require: (1) Low-latency real-time processing to analyse multiple speakers simultaneously; (2) Cloud-based architecture to handle concurrent users without performance degradation; (3) Adaptive algorithms that tailor feedback based on conversation context rather than using fixed thresholds. Additionally, improving multi-speaker tracking would allow the system to be deployed in larger groups, enabling scalable feedback mechanisms for team collaboration, education, and professional communication.

- **Effect over performance:** Another key area for future research involves shifting the focus from purely optimising system performance (i.e. minimising false positives) to evaluating the broader effect of feedback on dialogue quality and user perceptions. Study 2 demonstrated that some false positives were tolerated to prioritise the ultimate goal of improving engagement. While accuracy remains a crucial consideration, the emphasis should be on assessing how feedback notifications shape user awareness, interaction dynamics, and overall communication

satisfaction. Future research could also explore context-aware adaptive feedback mechanisms, adjusting the frequency, tone, or content of notifications based on individual user preferences or conversation type. This approach would provide a personalised, non-disruptive experience, ensuring that feedback remains supportive rather than corrective.

- **Differentiating meaningful vs. false positive interruptions:** One of the key challenges in automating conversational feedback is distinguishing between meaningful interruptions and natural dialogue variations. Some interruptions serve an important conversational function, such as backchanneling signals ("mm-hmm", "yeah"), which encourage participation rather than disrupt it. Future work should explore machine learning-driven prosodic analysis to assess tone, rhythm, and speaker intent, reducing the risk of misclassifying cooperative interruptions as disruptive.

- **Exploration of alternative feedback mechanisms:** Future studies should experiment with additional visual and auditory feedback modalities, such as adaptive notifications that evolve based on user preferences and task context. Gamified elements could also enhance user engagement, particularly in educational or professional training settings where real-time feedback could be used as a learning tool.

- **Expanding to multi-party settings:** As identified in participant feedback, adapting feedback systems for multi-party interactions is a crucial next step. This includes addressing group-level dynamics, such as ensuring balanced airtime among participants and mitigating dominance by any one individual. Advanced speech diarisation models could enhance feedback accuracy by better attributing speaking turns to specific users.

- **Personalised feedback delivery:** Investigating how feedback systems can dynamically adjust their tone, intensity, and content based on individual personality traits could enhance user satisfaction and effectiveness. For instance, more reserved users may prefer subtle cues, while assertive users may respond better to direct notifications.

- **Exploring longitudinal effects:** Finally, future research should examine the long-term impact of real-time feedback systems on user behaviour, communication satisfaction, and engagement. Understanding how users internalise and sustain behavioural adjustments over time could provide deeper insights into the efficacy of such systems in professional and social settings.

Collectively, these directions point toward a new generation of intelligent communication systems that do more than observe - they intervene gently, meaningfully, and with respect for user autonomy. This thesis lays the foundation for feedback designs that are

not only effective but also humane, adaptive, and scalable - offering practical solutions to a longstanding challenge in HCI and CMC.

4.7 Conclusion

This chapter contributes to the fields of CMC and HCI by formally defining and operationalising engagement metrics - speaking balance, pauses, and interruptions - as real-time, quantifiable indicators of conversational dynamics (see Section 4.3). These metrics introduce a novel lens for understanding digital interaction quality and form the basis of a structured framework for designing targeted feedback mechanisms. Unlike prior research that treated engagement abstractly or addressed these features in isolation, this work provides an integrated approach that is both measurable and actionable in live video-based conversations.

Across two studies (see Sections 4.4 and 4.5), the research demonstrates that engagement metrics can support behavioural change, improve interaction quality, and enhance user satisfaction. Study 1, using a Wizard-of-Oz setup, compared inter-meeting and real-time feedback, highlighting both the potential and limitations of synchronous intervention - particularly in terms of stress and intrusiveness. Study 2 built directly on these findings, introducing an automated system with co-designed visualisations. The resulting dashboard proved scalable and minimally intrusive, with measurable improvements in speaking balance, pauses and increased participant awareness without compromising comfort.

These contributions advance current understanding of how engagement in remote interactions can be supported dynamically, moving beyond static guidelines or moderator-led interventions. The present research is among the first to integrate automated metric detection with co-designed visualisation techniques in a real-time dyadic communication context. The research therefore positions itself at the intersection of engagement modelling, interface design, and communication support, offering a scalable, user-centred alternative to traditional moderation systems.

Looking forward, future research should investigate the longitudinal effects of real-time feedback, its extension to multi-party or cross-cultural settings, and opportunities for adaptive personalisation. As remote collaboration becomes increasingly central to professional and social communication, intelligent systems that enhance engagement - without undermining autonomy - are urgently needed.

Together with Chapter 3, which addressed trust and familiarity in unfamiliar dyads via asynchronous introductions, this chapter contributes the second half of a dual response to the overarching research question posed in Chapter 1: How can digital interventions meaningfully support engagement, trust, and communication quality in virtual

dyadic interactions? The final chapter (Chapter 5) draws together the findings from both strands - ASGPI and real-time engagement feedback - articulating their implications, limitations, and future directions in light of the thesis as a whole.

Chapter 5

Conclusions

This final chapter revisits the overarching research problem, synthesises key findings from the two central strands - ASGPI and synchronous real-time engagement feedback - and articulates the original contributions to knowledge. It reflects on the implications of these findings, addresses methodological and contextual limitations, and outlines future research directions. This chapter positions the thesis as a comprehensive investigation into how asynchrony and synchrony can be deliberately employed as design strategies to enhance engagement in video-based dyadic communication.

Across both empirical strands of work, behavioural measures are used to indicate what changed in interaction patterns, while RTA is used to explain how those changes were interpreted and experienced by participants.

5.1 Overarching Focus and Research Questions

This thesis set out to tackle a pressing issue in contemporary communication research: how to improve engagement in video-based dyadic communication, in contexts where individuals are either unfamiliar or familiar with one another, lack in-person cues, or experience conversational imbalance (i.e. uneven floor access, sustained speaking dominance, or disrupted turn exchange), which can lead to substantial barriers, including reduced trust, low communication satisfaction, and fragmented turn-exchange or reduced conversational coherence. Two interaction contexts were examined: an asynchronous context involving self-recorded video introductions prior to meetings, and a synchronous context involving real-time feedback mechanisms designed to enhance awareness of engagement metrics such as speaking balance, interruptions, and pauses. Through this lens, the thesis develops an integrated framework for enhancing social

presence and conversational quality in remote one-on-one settings, bridging communication theory, system design, and empirical evaluation in HCI. Throughout this chapter, the term conversational imbalance refers to interactional patterns within meetings, whereas the term methodological asymmetry refers to limitations in the evaluation design (i.e. baselines, comparators, task constraints, scope, and observation effects), and these two uses are kept distinct to avoid conceptual slippage.

The overarching research question guiding this work is thus restated below:

How to design for the triangular state of team dynamics in video meetings: trust, team effectiveness, and team satisfaction, through structured interventions that support collaboration across pre-meeting and in-meeting phases, while accounting for participant familiarity?

5.2 Answer to the Overarching Design Question

This thesis answers the question of how to design for trust, team effectiveness, and team satisfaction in dyadic video meetings by proposing a small set of phase-sensitive design claims grounded in the evidence across both intervention strands. These claims are expressed proportionately to the feasibility-stage scope of the studies and should be interpreted as design guidance under the studied conditions rather than as universal prescriptions.

- **First**, engagement support should be phase-matched to the meeting lifecycle. Pre-meeting scaffolding should prioritise rapid common ground formation and psychological safety under unfamiliarity, whereas in-meeting support should prioritise behavioural self-regulation under cognitive load when turn-taking cues are degraded. This claim is supported by the pattern that the pre-meeting AS-GPI strand primarily improved early trust-related perceptions and meeting-entry comfort, while the synchronous feedback strand primarily supported in-meeting awareness and communication satisfaction under live interaction constraints.
- **Second**, real-time feedback should be designed as shared and non-evaluative. Feedback is more likely to support mutual regulation when it is bilateral and framed as descriptive awareness rather than as performance judgement, because perceived evaluation risks undermining psychological safety and, by extension, trust and satisfaction. This claim is supported by participant accounts indicating that supportive, shared presentation reduced defensiveness and enabled reflection on both interrupting and being interrupted, whereas earlier salient feedback was experienced as more stressful and disruptive.

- **Third**, in-meeting feedback should minimise attentional demand through progressive disclosure and restrained update cadence. Because dyadic video interaction already imposes high monitoring demands, feedback interfaces should surface only what is necessary for moment-by-moment adjustment, with optional expansion when cognitive budget allows. This claim is supported by qualitative reports of distraction or overload when multiple cues competed for attention, alongside evidence that simpler, calmer visualisations were perceived as easier to use during live talk.

- **Fourth**, engagement support should preserve autonomy through configurability. Users should be able to pause, hide, or simplify feedback during demanding task moments, because autonomy reduces threat, supports psychological safety, and increases the likelihood of sustained uptake beyond novelty. This claim is supported by participant preferences for control over feedback visibility and for the ability to reduce pressure when real-time cues felt too salient.

- **Fifth**, out-of-meeting artefacts should be lifecycle-aware and context-bounded. ASGPIs are most defensible as time-bounded, purpose-specific introductions rather than static profiles, because reusability trades off efficiency with authenticity and risks staleness as roles and relationships evolve. This claim is supported by the mechanism-level rationale that ASGPIs accelerate grounding and reduce uncertainty at first contact, but the thesis does not provide evidence that repeated reuse retains the same interpersonal value.

- **Sixth**, deployment choices must explicitly address privacy and workplace power asymmetries. Engagement metrics intended for self-regulation should prioritise participant control, minimal retention, and clear boundaries that prevent repurposing for surveillance or performance management, because such repurposing would likely undermine the trust corner of the triangular state. This claim is supported by the ethical risk profile of behavioural instrumentation in hierarchical contexts, even when the same metrics are experienced as supportive within controlled study framing.

Through this focus, the research introduces an integrated set of interventions and analytical tools for improving social presence and conversational quality in remote one-on-one meetings. Two studies - the latter including further sub-studies - were conducted using technical prototypes, controlled experimental designs, and mixed-method evaluations. In doing so, the thesis deconstructs the digital affordances of virtual communication and makes use of asynchrony and synchrony as complementary mechanisms for enhancing engagement in mediated dyadic contexts, bridging design, communication theory, and HCI.

This thesis is governed by the triangular state of team dynamics in video meetings: trust, team effectiveness, and team satisfaction, and uses this stance as the evaluative lens through which both interventions are designed and interpreted. The two intervention strands are interpreted as complementary tests of this stance across the meeting lifecycle. The ASGPI intervention targets the pre-meeting establishment of common ground to accelerate early trust, while the real-time engagement feedback targets in-meeting self-regulation under cognitive load to protect effectiveness and satisfaction during live interaction. Together, the results provide evidence that structured design interventions can support the triangular state in dyadic video meetings under the studied conditions, with effects that differ by meeting phase and participant familiarity. These two intervention strands are interpreted through different theoretical lenses, with asynchronous support contextualised by MST, and synchronous engagement feedback grounded primarily in self-regulation and Cognitive Load perspectives, with SIPT used contextually to explain the social consequences of cue degradation.

5.3 Synthesis: Implications for the Governing Triangular State of Team Dynamics

This thesis set out to test a single governing claim: that a triangular state of team dynamics in video meetings, trust, team effectiveness, and team satisfaction, is design-sensitive, and can be supported through structured interventions introduced at different points in the meeting lifecycle. Rather than treating video-conferencing as a neutral channel, the thesis examined whether targeted scaffolding can strengthen one or more elements of the triangle without undermining the others, particularly when conversational cues are limited and participant familiarity varies.

5.3.1 How the Findings Advance the Governing Stance

Across both studies, the results provide evidence that deliberate structure introduced before and during dyadic video meetings can improve interaction outcomes that align with the triangular state. In unfamiliar dyads, ASGPI support enabled earlier interpersonal orientation and reduced uncertainty at meeting onset, which was reflected in improved trust-related perceptions and a more comfortable entry into task interaction. In familiar dyads, real-time engagement feedback supported behavioural self-awareness during live interaction and was associated with more balanced conversational dynamics and improved communication satisfaction. Taken together, these findings advance the governing stance by showing that trust, effectiveness, and satisfaction are not only outcomes of interpersonal skill but can be treated as design targets in mediated dyadic collaboration.

5.3.2 How the Findings Nuance the Governing Stance

The findings also nuance the triangular state by indicating that the three elements are not equally responsive to the same intervention at the same time. The evidence suggests a phase-dependent pattern. Pre-meeting scaffolding primarily influences the trust corner by accelerating early common ground formation, with downstream implications for perceived effectiveness and satisfaction as interaction progresses. In contrast, in-meeting feedback primarily protects effectiveness and satisfaction by supporting self-regulation under cognitive load when turn-taking cues are reduced, while trust-related effects are more indirect and dependent on how feedback is experienced. This distinction clarifies how different mechanisms map onto different corners of the triangle and provides a more precise account of how design interventions can be matched to meeting phase and participant familiarity.

5.3.3 Governing Stance: Nodes and Edges

To make explicit how the empirical evidence relates to the governing triangular state of team dynamics, this subsection summarises what was improved, what was not evidenced, and where findings remain early-stage for each node and for the relationships between them.

Nodes:

- **Trust, what improved:** In unfamiliar dyads, the ASGPI intervention was associated with reduced uncertainty at meeting onset and increased interpersonal orientation. These effects were reflected in trust-related self-report indicators and participant accounts describing greater ease, comfort, and readiness to engage at the start of the live interaction.
- **Trust, what was not evidenced:** The thesis does not establish durable changes in trust over time, nor trust effects in high-stakes organisational settings. It also does not provide evidence that real-time engagement feedback independently improves trust once novelty, observation effects, and task structure are accounted for.
- **Team effectiveness, what improved:** Evidence suggests improved coordination readiness following ASGPI exposure and improved regulation of balance-related behaviours, such as speaking dominance and interruptions, during synchronous feedback use. These effects were observed under the controlled task conditions employed in the studies.
- **Team effectiveness, what was not evidenced:** The thesis does not make strong claims about objective task performance improvements across contexts. Design

constraints, including strand-specific baselines and the absence of a complete factorial design, limit causal attribution beyond mechanism-supported behavioural associations.

- **Team satisfaction, what improved:** Communication satisfaction improved most consistently in the synchronous engagement feedback strand, alongside perceived fairness, mutual awareness, and interpretive clarity regarding conversational dynamics.
- **Team satisfaction, what was not evidenced:** The thesis does not establish long-term satisfaction effects, nor whether satisfaction gains persist once feedback becomes routine or when interaction occurs without experimental framing.

Edges:

- **Trust to satisfaction:** Early trust-related comfort appeared to support smoother entry into interaction and a more relaxed conversational climate. However, the thesis cannot establish mediation pathways between trust and satisfaction without interaction-level qualitative analysis of conversational sequences.
- **Effectiveness to satisfaction:** Behavioural regulation supported by real-time feedback was associated with improved satisfaction when feedback remained low-threat and non-intrusive. Conversely, when visual monitoring was experienced as distracting or stress-inducing, satisfaction was negatively affected, indicating a conditional relationship between effectiveness support and satisfaction.
- **Trust to effectiveness:** ASGPI exposure likely supported effectiveness indirectly by reducing early uncertainty and facilitating grounding before task interaction. However, this relationship remains suggestive rather than causally established within the present feasibility-focused design.

5.3.4 Interpretive Scope of the Qualitative Findings

Across both studies, qualitative findings are interpreted relative to the thesis' governing constructs of trust, social presence, and cognitive load, rather than as fine-grained accounts of task execution or interactional sequencing. RTA was used to capture how participants made sense of engagement support, feedback visibility, and conversational balance, and how these experiences shaped perceived comfort, fairness, and satisfaction during mediated interaction.

Within this interpretive frame, trust-related themes emerged most strongly in the asynchronous strand, where participants described reduced uncertainty, increased interpersonal orientation, and greater ease at meeting onset. These effects are understood

as shifts in perceived social presence and psychological safety, rather than as direct behavioural transformations observable within task talk. In contrast, qualitative themes in the synchronous strand primarily map onto cognitive load and self-regulation constructs, with participants describing heightened awareness, moment-by-moment behavioural adjustment, and changes in perceived effort and stress during live interaction.

Importantly, the qualitative analysis did not attempt to reconstruct what happened within tasks at the level of turn-by-turn coordination, repair, or sequential organisation. As such, the thesis does not provide a parallel qualitative account of task interaction to accompany behavioural measures. This was a deliberate methodological trade-off, aligned with the feasibility-oriented and design-led aims of the research. Analysing task talk itself would have required interaction-focused qualitative methods, such as Conversation Analysis or interaction analysis, supported by fine-grained transcription and temporal annotation, which fell outside the scope of the present body of work.

Future research could address this limitation by combining real-time engagement metrics with interaction-level qualitative analysis, enabling closer examination of how feedback alters the unfolding structure of task talk, turn transitions, and coordination strategies. Such work would allow direct linkage between behavioural change, interactional mechanics, and participant meaning-making, strengthening causal interpretation while preserving the interpretive strengths demonstrated in this thesis. This would enable more direct interpretation of mechanism pathways, i.e. how trust and social presence are shaped through specific interactional events, and how cognitive load is redistributed during live regulation.

5.3.5 What the Findings Do Not Establish

The thesis makes proportionate claims based on the scope of evidence. All studies were conducted in dyadic settings, using controlled or semi-scripted tasks, within short-timed windows, and largely within a single language and cultural context. The real-time system also employed fixed operational thresholds for pauses and interruptions, which may not align with all conversational styles. Therefore, the findings should not be interpreted as demonstrating universal improvement of team dynamics across all meeting types. Instead, they provide evidence that, under the studied conditions, targeted pre-meeting and in-meeting structures can support elements of the triangular state, and that the form and timing of support matters for which element shifts most strongly. These findings therefore refine the governing stance by indicating that design sensitivity is conditional on meeting phase, familiarity, and the intrusiveness of the intervention.

Finally, because each intervention was evaluated in the context for which it was designed, unfamiliar dyads for pre-meeting introductions and familiar dyads for in-meeting feedback, the thesis does not estimate interaction effects between familiarity and intervention presence within a single factorial structure. This design choice reduced confounding within each strand but constrains claims about how the same intervention would perform across different familiarity contexts. As such, conclusions are appropriately limited to mechanism-supported effects within the studied conditions, rather than universal effects across all dyadic configurations.

From a causal perspective, the thesis does not estimate baseline effects or interaction effects within a complete factorial design. The absence of a no-intervention baseline and a full 2×2 crossing of participant familiarity and intervention presence constrains causal attribution to mechanism-supported associations within each studied context, rather than population-level causal effects. These limitations are consistent with the feasibility-stage, design-led nature of the research. Completing the factorial matrix and introducing baseline conditions therefore represents a clear next step for future work, enabling formal testing of interaction effects and stronger causal inference across meeting phases.

5.4 Positioning the Theoretical Accounts Used in This Thesis

Because this thesis integrates two distinct intervention phases, asynchronous pre-meeting support and synchronous in-meeting feedback, it also draws on different theoretical traditions to explain why and how each intervention operates. This subsection clarifies the role and scope of the psychological and HCI theories employed across the thesis, with particular attention to addressing the different explanatory demands of asynchronous and synchronous interaction. While MST and SIPT are used to contextualise how mediated communication shapes social interpretation over time, the behavioural mechanisms underpinning the synchronous feedback systems are more directly grounded in self-regulation and Cognitive Load perspectives. This clarification ensures a coherent theoretical line across both strands while avoiding over-extension of any single theory beyond its explanatory scope.

While earlier chapters referenced SIPT to situate the social consequences of cue degradation in video-mediated communication, it is important to clarify its role in relation to the synchronous interventions evaluated in this thesis. SIPT primarily explains how relational meaning, trust, and social understanding emerge over time as individuals adapt to reduced or altered cues in mediated environments. As such, it is well suited to explaining why cue loss in video interaction becomes socially consequential, but it does not provide a direct account of how individuals regulate conversational behaviour moment-by-moment during live interaction.

The synchronous engagement feedback systems evaluated in Chapter 4 are therefore more accurately grounded in psychological theories of self-regulation and Cognitive Load, rather than SIPT. These studies investigate how externalising conversational dynamics, such as interruptions, pauses, and speaking balance, reduces the internal monitoring burden placed on participants during live interaction. By offloading self-monitoring demands onto a shared, non-evaluative visual system, the interventions support behavioural regulation under conditions of degraded turn-taking cues.

SIPT is retained in this thesis as a contextual explanatory framework, clarifying why misaligned cues in video-based communication lead participants to infer dominance, disengagement, or attentiveness in socially meaningful ways. However, the mechanisms through which behavioural change occurs in synchronous settings are better explained by self-regulatory processes operating under cognitive load, rather than by the gradual relational adaptation assumed by SIPT. From this perspective, the contribution of this work lies not in extending SIP directly, but in demonstrating how self-regulation systems can be designed to operate alongside socially grounded interpretations of mediated interaction. Future theoretical work may seek to integrate SIPT with models of real-time regulation, but within the scope of this thesis, synchronous feedback systems are most appropriately framed as self-regulation technologies rather than social inference mechanisms.

In contrast, the asynchronous ASGPI intervention is appropriately grounded in theories concerned with information preparation, common ground formation, and reduced synchronicity demands, and does not require real-time self-regulatory support. Together, this separation reinforces the thesis' core claim that engagement support mechanisms must be theoretically matched to meeting phase and cognitive demands, rather than explained through a single unified theory.

5.5 Summary of Contributions

This thesis makes several original contributions to knowledge, situated at the intersection of CMC, HCI, engagement research, and interactive system design:

1. **Formalisation and operationalisation of ASGPI:** This research introduces and empirically evaluates ASGPI as a structured, pre-meeting strategy for improving perceived effectiveness and supporting early trust formation in unfamiliar dyadic video meetings. The contribution lies not only in proposing ASGPI but in implementing and testing it in a controlled, experimental setting. The design of the ASGPI was informed by the Professional Familiarity Questionnaire, developed as part of this work from existing literature to capture the key pillars of

professional familiarity. By aligning the structure of ASGPI with these empirically grounded components and analysing both behavioural and perceptual outcomes, the research shows that ASGPI can reduce social awkwardness, support rapport-building, and provide a low-pressure entry point into virtual meetings. This contribution primarily strengthens the trust corner, with downstream implications for effectiveness and satisfaction.

2. **Definition and implementation of engagement metrics in real-time systems:** The research defines and operationalises three core engagement metrics - interruptions, pauses (intra- and inter-turn), and speaking balance - in the context of synchronous dyadic communication. These were embedded into a feedback system using inter-meeting engagement summary sheets, real-time race-track visualisations and subtle on-screen indicators. Formalising engagement as a set of computable, real-time measures represents a novel contribution to feedback design in HCI and CMC. This primarily targets effectiveness and satisfaction by supporting self-regulation under cognitive load, as participants adapt to misaligned conversational cues during live interaction.

3. **Comparative evaluation of feedback timing and delivery:** A sequential comparison of inter-meeting and real-time feedback delivery revealed that the former supports reflective awareness, while the latter fosters immediate behavioural change. Study 2 addressed prior stress-inducing limitations by integrating user-informed visualisations that were supportive rather than prescriptive, resulting in improved communication satisfaction and more balanced dialogue. This clarifies how timing moderates which parts of the triangle shift, reflective trust-building versus in-meeting effectiveness maintenance.

4. **Integration of quantitative and qualitative findings across studies:** A mixed-methods approach combining statistical hypothesis testing with thematic analysis enabled a deeper understanding of both behavioural and perceptual changes. This methodological integration, grounded in behavioural psychology, revealed that increased awareness of both interrupting and being interrupted reduced defensiveness and fostered mutual empathy. Positive stress was also interpreted as a motivator for improvement rather than a source of disruption. This explains how perceived fairness and mutual empathy shape satisfaction and indirectly reinforce trust.

5. **Design principles for future feedback systems in dyadic settings:** Drawing on participant feedback and empirical results, the research proposes core design principles for future systems: feedback should be low-intrusion under configurable visibility, user-customisable, balanced in tone, and scalable to multi-party settings. These principles address the real-world need for communication tools that support equitable participation in remote work, learning, and social contexts.

These principles operationalise how systems can support all three corners of the triangular state of team dynamics without increasing cognitive burden.

Together, these contributions advance both theoretical and practical understanding of how to shape and improve engagement in video-based, mediated dyadic communication, using carefully structured interventions grounded in user needs and empirical validation.

5.6 Applied and Ethical Implications for Real-World Deployment

While this thesis demonstrates that structured asynchronous and synchronous interventions can meaningfully support engagement in dyadic video communication, their translation into real-world systems introduces important design, ethical, and organisational considerations. These implications are particularly important when the interventions are considered together as a two-phase engagement support system, operating before and during meetings to stabilise different elements of the triangular state of team dynamics. Addressing these issues is essential for positioning the contribution at the forefront of applied HCI research, where questions of scalability, governance, and unintended consequences become as important as efficacy.

5.6.1 Reusability Trade-offs Across Meeting Phases: Authenticity, Staleness, and Scale

A central-applied implication concerns reusability trade-offs across both intervention phases. In the asynchronous case, ASGPIs were shown to accelerate early trust formation and reduce awkwardness in unfamiliar dyads. However, repeated reuse of the same recorded introduction raises questions of authenticity decay and staleness. Over time, introductions may become outdated, overly performative, or misaligned with evolving roles, goals, or interpersonal histories. This introduces a trade-off between efficiency and authenticity: systems that privilege reuse reduce preparation effort, but risk diminishing sincerity and relational value, while systems that require frequent re-recording may introduce fatigue and resistance.

These trade-offs become more pronounced when considering scale. In larger organisational settings or multi-party meetings, expecting participants to watch numerous pre-recorded introductions may be impractical. This suggests that ASGPIs are most effective when treated as contextual, time-bounded artefacts rather than static profiles. Practical deployments may therefore require mechanisms such as expiration windows,

selective visibility, summarisation, or adaptive prompting, allowing introductions to function more like lightweight digital identity snapshots or situational narratives rather than permanent records. Framing ASGPIs as evolving, purpose-driven artefacts aligns with their role in supporting the trust corner of the triangular state without imposing unnecessary cognitive or temporal burden as teams grow or stabilise.

Similar reusability considerations apply to synchronous engagement feedback. While real-time metrics can support effectiveness and satisfaction by encouraging balanced interaction, repeated exposure to the same feedback cues may lose salience over time or become routinised. This suggests that feedback systems may benefit from adaptive emphasis, where different engagement dimensions are foregrounded depending on meeting type, task demands, or team maturity. Together, these findings indicate that both out-of-meeting and in-meeting interventions require lifecycle-aware design to remain effective without becoming stale or intrusive, and to preserve effectiveness without eroding trust or perceived authenticity over time.

5.6.2 Privacy, Surveillance, and Power Asymmetries Across Interventions

Both ASGPIs and real-time engagement metrics raise important privacy and power considerations when deployed beyond experimental settings. Although ASGPIs are self-authored and voluntary, their persistence introduces questions about control, audience, and future reuse. Participants may be comfortable sharing contextual information for a specific meeting, yet less comfortable with indefinite storage or secondary use, particularly in organisational environments where information asymmetries already exist.

These concerns are amplified in the case of synchronous engagement metrics. Although the feedback system was explicitly designed to support self-regulation rather than external evaluation, the same metrics could be repurposed for managerial oversight or performance assessment if deployed without safeguards. Continuous measurement of interruptions, pauses, or speaking balance may be experienced as surveillance, particularly in hierarchical contexts where conversational behaviour could be interpreted as competence, dominance, or disengagement.

Across both intervention phases, preserving trust requires clear boundaries around data ownership, visibility, and persistence. Applied systems should prioritise participant control, local processing where possible, and momentariness, ensuring that feedback supports reflection in the moment rather than retrospective auditing. Without such constraints, interventions intended to strengthen the triangular state may undermine it - particularly the trust corner - by introducing anxiety, self-censorship, or performative interaction.

To support responsible deployment, systems implementing ASGPIs or real-time engagement metrics should make a small set of governance choices explicit at design-time and at use-time. Where feasible, processing should default to on-device or local computation, with minimal or zero retention of raw conversational data and a presumption of momentariness for derived metrics. Visibility should be participant-controlled, with clear meeting-level consent prompts and opt-in activation rather than default-on instrumentation. Crucially, deployment should enforce an explicit separation between engagement support and performance management, including role-based protections in hierarchical contexts, to reduce the likelihood that supportive feedback is reinterpreted as surveillance or used to disadvantage participants with less organisational power.

5.6.3 Priming, Demand Characteristics, and Behavioural Shaping

Another applied implication concerns behavioural priming and demand characteristics across both intervention types. In both studies, participants were made aware that aspects of their communication were being structured, measured, or visualised. As a result, some observed behavioural changes may reflect heightened self-monitoring, short-term compliance, or novelty effects rather than durable shifts in conversational practice.

Rather than invalidating the findings, this highlights a fundamental design reality: awareness is itself an intervention. Both ASGPIs and real-time engagement feedback shape behaviour by making expectations, norms, or interactional features explicit. In applied settings, designers must therefore consider how much behavioural change arises from reflective self-regulation versus performative adjustment. This reinforces the importance of subtle, non-judgemental feedback that supports awareness without encouraging artificial, strained, or overly self-conscious interaction. From a triangular state perspective, excessive priming may stabilise effectiveness in the short term while inadvertently weakening satisfaction or perceived authenticity.

5.6.4 Feasibility Framing and Organisational Adaptation

Finally, both intervention strands should be framed as feasibility-stage contributions rather than fully-generalisable solutions. The systems were evaluated in controlled dyadic settings, using fixed thresholds, short interaction windows, and specific task structures. These conditions support internal validity but limit claims about robustness across diverse organisational cultures, conversational norms, or meeting types.

The contribution therefore lies in demonstrating that engagement support is possible, interpretable, and beneficial under specific conditions, and in articulating how such

systems might be adapted rather than universally applied. In organisational deployment, this may involve tailoring engagement metrics to departmental goals, meeting formats, or task types. For example - emphasising interruption reduction in debate-heavy contexts, or speaking balance in mentoring or onboarding settings. Similarly, ASGPIs may require different templates or prompts depending on whether the goal is rapport-building, role clarification, or rapid task alignment.

Framing both systems as early-stage, design-led prototypes strengthens the thesis contribution by aligning empirical evidence with proportionate claims about readiness. It positions the work not as prescribing fixed behavioural standards, but as providing a principled foundation for future systems that adapt engagement support to context, scale, and organisational need.

5.7 Limitations

While the thesis presents a comprehensive and multi-method investigation, certain limitations remain:

1. **Dyadic focus:** All studies were limited to dyadic interactions. This was intentional, given the methodological control it affords. However, this limits generalisability to group contexts, where dynamics such as groupthink, turn competition, or hierarchical speaking patterns may alter engagement behaviours;
2. **Controlled settings:** Participants interacted in semi-scripted or task-based settings rather than organic meetings. While this enabled comparability across sessions, it may not reflect the full variability of real-world use;
3. **Short-term engagement measurement:** The thesis measured changes within or between short sessions. Although longitudinal patterns emerged among returning participants that evaluated a new form of feedback, this thesis did not evaluate whether participants retain improved behaviours or awareness over time;
4. **Automated metric thresholds:** The real-time feedback system employed fixed thresholds for defining interruptions and pauses. While based on literature and focus group input, these thresholds may not align with all conversational norms or individual speaking styles;
5. **Wizard of Oz subjectivity:** Parts of the synchronous evaluation employed Wizard of Oz facilitation during early prototyping, which introduces experimenter judgement into when and how feedback is triggered. This increases feasibility during development but limits reliability and replicability, because the same conversational episode could be labelled differently by different operators. Findings from Wizard of Oz phases are therefore interpreted as design feasibility and

mechanism sensitivity evidence rather than definitive estimates of automated system performance;

6. **Interface-attention costs and cognitive load:** Real-time visual feedback necessarily competes for attentional resources with the ongoing conversation and task. Even when cues are designed to be subtle, the interface can impose cognitive load through monitoring demands, visual salience, and the need to interpret changing indicators. This creates a validity constraint: observed behavioural shifts may reflect attentional reallocation or compliance with perceived system expectations, rather than purely improved self-regulation under naturalistic conditions;

7. **Language and cultural bias:** All participants were proficient English speakers, and most shared cultural norms. This raises questions about how well the system would perform in multilingual or culturally diverse settings where conversational cues differ. Conversational norms such as turn-taking behaviour, silence interpretation, and backchannel frequency can differ significantly across cultural settings, potentially limiting generalisability.

5.7.1 Ecological Validity, Task Structure, and Observation Effects

A key limitation concerns ecological validity across both intervention strands. The empirical work relied on structured interaction formats to support comparability, including prompted discussion and role-play tasks rather than fully naturalistic meetings. Although these tasks were designed to elicit collaboration and conversational turn-exchange, the move from relatively open conversation into role-play introduces task-driven constraints on turn-taking, topic control, and speaking rights that may not reflect how dyads naturally coordinate in workplace meetings. In particular, role-play can encourage performance, heightened assertiveness, or exaggerated conversational moves, and can also reduce the relevance of certain cues that would normally regulate spontaneous turn-taking. As a result, measured changes in interruptions, pauses, or speaking balance may partially reflect task affordances rather than intervention effects alone. This limitation is especially relevant when interpreting fine-grained timing measures, because scripted or semi-scripted task phases can compress response latencies and increase overlap relative to everyday talk.

Related ecological validity considerations also apply to the asynchronous ASGPI intervention. While self-guided professional introductions were designed to reflect realistic onboarding or first-meeting preparation practices, their experimental use involved explicit prompts and short-term evaluation contexts that may heighten self-presentation awareness. Participants knew that introductions were created for study purposes and would be viewed by a specific partner in an evaluative setting, which may encourage more polished, strategic, or performative disclosure than would occur in everyday professional contexts. Consequently, observed trust and comfort effects may partly reflect

heightened intentional self-disclosure under study conditions, rather than fully naturalistic pre-meeting behaviour. These effects are consistent with a feasibility-stage evaluation but constrain inference about how ASGPIs would be used, reused, or adapted in ongoing organisational practice.

A second limitation concerns observation effects, including Hawthorne effects and demand characteristics, across both strands. Because observation and instrumentation were unavoidable in both intervention strands, the evaluation adopted a partial Hawthorne control strategy intended to distinguish intervention sensitivity from simple participation effects. Participants were explicitly aware that the interaction was part of a study, and, in the synchronous strand, that aspects of conversational behaviour were being monitored and visualised. In the asynchronous strand, participants were similarly aware that introductions were authored for research purposes and would be viewed by a partner within an evaluative setting, which may have increased impression management. This strategy consisted of three elements: non-evaluative framing (presenting the tools as supporting mutual awareness rather than performance assessment), standardised task structure and ordering to stabilise interaction opportunities, and a within-dyad comparison in the synchronous strand (a first meeting without real-time feedback followed by a comparable second meeting with feedback). In the asynchronous strand, standardised ASGPI prompts and consistent timing of introduction exchange were used to reduce variability in preparation and exposure. Importantly, these same partial controls also introduce demand characteristics, to the extent that standardisation, framing, and within-dyad comparison may implicitly signal the behaviours the study values, such as balanced participation, reduced interruption, and visible self-regulation. As a result, some behavioural change may reflect short-horizon compliance or performative adjustment rather than durable conversational change. Accordingly, observed changes are interpreted as evidence of mechanism responsiveness under observation rather than as stable estimates of real-world behavioural adoption. These constraints are consistent with a feasibility-stage evaluation, but they limit inference about how the interventions would function when observation is weaker, stakes are higher, and interaction is less structured.

Finally, task structure and observation effects interacted with design decisions across the body of work, but in different ways across the two strands. The real-time engagement feedback system underwent explicit iterative refinement, with early prototypes in the first study intentionally salient to test feasibility and mechanism clarity. Participant responses indicated that highly visible live feedback could be disruptive or stress-inducing, leading to subsequent redesigns toward subtler, bilateral, and less-judgemental presentation using user-informed visual metaphors and reduced visual aggressiveness. In addition, even subtle real-time cues introduce an interface-attention

cost, meaning that part of the measured effect may reflect participants reallocating attention in response to the dashboard rather than purely improved conversational regulation. In contrast, the ASGPI intervention did not undergo iterative empirical refinement within the scope of this thesis, but was designed upfront based on theory, prior literature, and feasibility considerations. Nevertheless, participant reports and qualitative reflections revealed that overly-rigid or prescriptive introduction prompts risk by sounding performative or inauthentic, highlighting a design tension between structure and authenticity in asynchronous self-presentation. These observations inform interpretation rather than constituting a formal design iteration. While these design choices improved acceptability and perceived fairness within the studied conditions, unresolved questions remain about long-term habituation, authenticity over repeated use, and how both interventions operate in task-free, high-stakes, or fully naturalistic meeting contexts.

To reconcile claims of minimal intrusiveness with reports of overload, the real-time feedback should be treated as minimally-intrusive only under specific interface configurations and attentional budgets, rather than as a universal property of feedback visibility. Participant reports of distraction or visual overload are therefore interpreted as evidence that the same mechanism can become intrusive when too many elements compete for attention. A practical UI simplification pathway would prioritise progressive disclosure, showing only one metric at a time by default (i.e. speaking balance or interruptions or pauses), with optional expansion to multi-metric views, alongside an always-available ability to hide or pause the dashboard during demanding task moments. Visual salience should also be reduced through fewer concurrent animations and a calmer, lower-frequency update cadence, preserving interpretability without continuous attentional capture. These simplifications should be evaluated explicitly by measuring interface-attention costs (i.e. glance frequency and dwell time), perceived cognitive load, and dual-task performance impacts, and by testing habituation across repeated sessions to determine whether overload diminishes or persists over time.

5.7.2 Limitations of the ASGPI Evidence Base

Several limitations constrain interpretation of the ASGPI findings.

- **First**, the evaluation does not include a universal no-intervention baseline or a complete factorial crossing of participant familiarity and intervention presence. ASGPIs were evaluated exclusively in unfamiliar dyads, because their purpose is undermined once familiarity is established. While this design choice reduces confounding and improves mechanism interpretability, it limits causal attribution and prevents estimation of interaction effects between familiarity and intervention presence.

- **Second**, the use of pre-recorded self-guided introductions introduces risks related to authenticity and staleness. Although ASGPIs were effective in reducing early uncertainty under study conditions, repeated reuse of recorded artefacts may encourage performative self-presentation or become misaligned with evolving roles, goals, or interpersonal histories. These dynamics may alter how introductions are interpreted over time and constrain their long-term effectiveness in applied settings.
- **Third**, Hawthorne effects and priming are likely contributors to observed trust-related outcomes. Participants were explicitly prompted to introduce themselves and were aware that their introductions would be viewed by a partner within an evaluative context. This awareness may have increased intentional self-disclosure, impression management, or politeness behaviours, inflating early comfort and trust indicators relative to more naturalistic pre-meeting preparation.
- **Finally**, the qualitative component of the ASGPI study employed RTA to capture participant interpretations of comfort, trust, and preparedness. While this approach is appropriate for understanding meaning-making, it does not provide interaction-level explanation of how specific conversational behaviours emerged during task talk. As such, the qualitative evidence explains how ASGPIs were experienced, rather than how they altered the sequential organisation of interaction.

5.7.3 Limitations of the Engagement Feedback Evidence Base

The synchronous engagement feedback studies are subject to several intervention-specific limitations.

- **First**, the measurement validity of speaking balance, interruptions and pauses is constrained by the use of fixed operational thresholds. Although threshold values were informed by prior literature and focus group input, they may not align with all conversational styles, backchannel norms, or cultural expectations. Audio latency, overlap tolerance, and individual speaking tempo further complicate interpretation, meaning that behavioural metrics should be understood as proxies for imbalance rather than definitive indicators of conversational quality.
- **Second**, early phases of the synchronous evaluation relied on Wizard of Oz facilitation to trigger feedback during live interaction. Operator judgement necessarily influenced when feedback was presented, introducing subjectivity and limiting replicability. Findings from the Wizard of Oz phase are therefore interpreted as feasibility-stage evidence of mechanism sensitivity rather than as validated estimates of automated system performance.

- **Third**, real-time visual feedback introduces interface-attention costs and cognitive load. Even when designed to be subtle, monitoring a dashboard during live conversation constitutes a dual-task demand. Observed behavioural changes may therefore partially reflect attentional reallocation, compliance with perceived system expectations, or momentary self-monitoring rather than durable improvements in conversational regulation.
- **Finally**, Hawthorne effects and priming are particularly salient in synchronous feedback contexts. Participants were aware that aspects of their conversational behaviour were being monitored and visualised, which may have shaped behaviour independently of feedback content. As a result, behavioural changes observed during feedback sessions are interpreted as evidence of short-horizon mechanism responsiveness under observation, rather than as stable conversational change transferable to uninstrumented settings.

5.8 Future Research Directions

Building on the limitations and promising results identified in this thesis, several directions for future work emerge. Each proposed avenue extends the theoretical and practical foundation established by the ASGPI framework and the real-time feedback system evaluated across studies.

1. **Multi-party scalability:** The current implementation was designed for dyadic settings to ensure experimental control. Future research should extend this system to multi-party interactions, where overlapping dialogue, group dynamics, and visibility of engagement metrics become more complex. The out-of-meeting feedback, race-track visualisation and live prompts architecture offer a foundation that could be scaled through enhanced speaker diarisation, multi-stream audio input, and distributed visual feedback tailored to group settings. Moreover, the ASGPI model raises important questions in multi-party contexts - i.e. how many introductions are appropriate, in what sequence they should be viewed, and how to manage participant attention and fatigue when multiple asynchronous videos (i.e. 6–10) must be watched before a group meeting. Future research could explore adaptive sequencing, summary introductions, or modular templates to ensure scalability without undermining familiarity or engagement;
2. **Personalised feedback tuning:** The fixed thresholds for interruptions and pauses, while functional, may not reflect individual communication preferences or cognitive styles. Future iterations could integrate adaptive thresholding informed by personality profiles, prior speaking behaviour, or conversational roles. Similarly, ASGPI content could be tailored based on users' professional background or

preferred self-presentation style, making the introduction process more engaging and context-relevant. This would build on the current system's modular structure and visual feedback mechanisms, enhancing responsiveness and perceived fairness;

3. **Longitudinal studies:** While short-term behavioural and perceptual changes were captured, longer-term effects remain unexplored. Longitudinal studies could assess whether improvements in engagement, awareness, and satisfaction are sustained over time, particularly in recurring team-based settings. In parallel, it would be valuable to track whether early familiarity developed through ASGPIs endures over repeated interactions, or whether periodic context-focused reintroductions are needed to maintain relational context. The availability of returning dyads in Study 2 of the previous chapter offers a preliminary indication that such tracking is feasible and informative;

4. **Naturalistic deployment:** Controlled tasks provided consistency for comparison, but future research should pilot the system in more naturalistic environments such as remote hiring, online classrooms, or teletherapy. In these contexts, ASGPI could serve as a lightweight onboarding mechanism, helping participants establish rapport before live sessions. The current system's flexibility, subtle visual feedback, and web-based deployment make it well suited to exploratory field trials, which would uncover real-world constraints and usage patterns. Such deployments are also necessary to test whether the observed behavioural shifts persist when conversation is task-authentic, less performative, and embedded in real-meeting stakes, addressing ecological validity limits of the role play based evaluation;

5. **Cross-cultural validation:** The studies recruited participants with similar linguistic and cultural backgrounds. To increase generalisability, future work should test the system in multilingual or multicultural contexts, where engagement norms differ in turn-taking, interruption tolerance, and silence. ASGPI content could also be adapted to reflect culturally appropriate self-disclosure norms or professional and even personal etiquette, ensuring comfort and relatability across diverse user groups. The current metrics could serve as a comparative baseline to identify culturally-specific adjustments required in system design;

6. **Gamified or multimodal feedback:** While the present study prioritised subtlety and non-intrusiveness, engagement could be further enhanced in certain contexts (such as education or training) through gamified elements. Visual milestones, progress indicators, or auditory cues could be layered onto the existing feedback model to boost motivation, particularly in formative learning settings. Different ASGPI types could similarly be expanded to include guided prompts, badges for profile completeness, or feedback on clarity and tone, transforming the pre-meeting stage into an active engagement phase;

7. **Semantic enrichment of feedback:** The current metrics assess *how* participants speak, but not *what* they contribute with. Future systems might incorporate semantic classification to detect conversational functions - such as introducing ideas, signalling agreement, or asking clarifying questions. This would expand the scope of engagement measurement and enable a more comprehensive model of conversational quality. ASGPI content might also be analysed semantically to detect alignment or divergence in participant goals, allowing systems to surface potential collaboration synergies before meetings begin;

8. **Validation of engagement metric thresholds and automation fidelity:** Future work should explicitly validate the operational definitions used for interruptions and pauses, because fixed thresholds trade interpretability and repeatability for potential mismatch with conversational style and context. A practical validation approach would include four steps: (1) First, create an annotated benchmark dataset of dyadic video conversations, with multiple trained annotators labelling interruptions, backchannels, and intra-pauses and inter-pauses. Inter-rater reliability should be quantified, for example using Cohen's kappa or Krippendorff's alpha, to establish the human agreement ceiling for each metric. (2) Second, calibrate thresholds against these annotations using a held-out evaluation procedure. Candidate thresholds for interruption length and pause length should be swept across plausible ranges, selecting values that optimise agreement with human labels while maintaining robustness to latency and audio dropouts. Performance should be reported using precision, recall, and scores, rather than only descriptive counts. (3) Third, test sensitivity to context by repeating calibration across task types and conversational styles, including low-stakes talk, problem-solving talk, and role-play, to quantify how stable the thresholds are across meeting formats. Where instability is high, adaptive or role-conditioned thresholding can be introduced, but only after reporting baseline fixed-threshold performance. (4) Fourth, replace Wizard of Oz triggers with automated detection and conduct an equivalence check between Wizard of Oz and automated triggering. This can be operationalised as agreement between trigger events and their timing, and by testing whether the same direction of behavioural and perceptual effects is observed when the operator is removed. Together, these steps would directly address reliability, validity, and replicability limits by separating metric definition from interface influence and by formalising how conversational events are detected under real meeting conditions.

5.9 Closing the Loop

Chapter 1 framed engagement in dyadic video meetings as design-sensitive, arguing that participation quality can be shaped through structured support deployed across

different phases of the meeting lifecycle, rather than treated as a fixed interpersonal trait or as a property of the communication channel alone. Chapter 2 then established the triangular state of team dynamics - trust, team effectiveness, and team satisfaction - as the governing evaluative lens, and proposed that different meeting phases place different demands on the triangle and therefore require phase-mapped intervention strategies.

Across the empirical body of work, the evidence supports this phase-mapped claim in a proportionate way. Pre-meeting ASGPI scaffolding was most consistently associated with early trust-related comfort and reduced uncertainty in unfamiliar dyads, whereas in-meeting engagement feedback was most consistently associated with improved awareness, balance-related behavioural regulation, and communication satisfaction during live interaction. This pattern provides feasibility-stage support for the triangular framework as a design lens, indicating that the triangle is responsive to intervention timing and form, and that design sensitivity is conditional on meeting phase and participant familiarity. At the same time, the evidence also qualifies the triangular framework in two important ways: (1) First, the absence of a no-intervention baseline and the lack of a full 2×2 factorial crossing of familiarity and intervention presence constrain causal attribution, limiting claims to mechanism-supported associations within the studied contexts; (2) Second, because the qualitative evidence prioritised participant meaning-making rather than interaction-level sequencing, the thesis cannot trace node-to-node pathways within the triangle, i.e. whether early trust shifts mediate later effectiveness or satisfaction, or whether regulation effects mediate perceived fairness and comfort.

The most direct next studies to close these gaps are therefore methodological as well as design-oriented. A complete 2×2 evaluation crossing participant familiarity (unfamiliar versus familiar) and intervention presence (present versus absent) would enable formal testing of interaction effects and stronger causal inference, particularly if paired with improved baseline conditions and longitudinal follow-up. In parallel, incorporating interaction-level qualitative analysis alongside RTA would enable mechanism tracing across the triangle by linking behavioural change to conversational sequences, turn transitions, and repair, thereby directly testing whether and how the triangular state operates as an explanatory model as well as an evaluative lens.

5.10 Final Remarks

This thesis demonstrates that asynchrony and synchrony can be deliberately and effectively operationalised to shape, manage, and improve engagement in video-based dyadic communication. By framing engagement as both a social and computational construct, it contributes a novel synthesis of design, theory, and empirical research.

This research situates MST and SIPT as contextual accounts of mediated communication, while foregrounding Common Ground with psychological safety, and Cognitive Load with self-regulation as phase-specific psychological mechanisms that justify intervention design in asynchronous and synchronous contexts.

Through the development and evaluation of two distinct but complementary systems: (1) ASGPI for asynchronous rapport-building and (2) real-time engagement feedback for synchronous behavioural modulation; the research offers practical tools of feedback and theoretical insights into the mechanics of digital interaction. It addresses an urgent need for more inclusive, balanced, and responsive communication tools in the age of remote work and distributed collaboration.

Overall, the thesis demonstrates that deliberately designed pre-meeting and in-meeting structures can strengthen what is referred to here as a triangular state of team dynamics - trust, team effectiveness, and team satisfaction - in video-based dyadic communication. These findings establish a cohesive governing argument while explicitly delimiting claims to the feasibility stage of intervention design, linking both studies and extending the field's ability to design for high-quality remote collaboration. In establishing expertise in the design and evaluation of engagement-enhancing systems, this work offers a roadmap for researchers, developers, and practitioners seeking to create more responsive, inclusive, and human-centred communication technologies.

Data Availability

The dataset associated with this thesis is available via the University of Southampton Research Repository:

https://doi.org/10.5258/SOTON/PG/D257

Appendix A

Supporting Materials (Chapter 3)

A.1 Participant Information Sheet

UNIVERSITY OF Southampton

Participant Information Sheet

Study Title: Studying Self-Disclosure Interactions to Improve Virtual Teams Effectiveness

Researcher: George Muresan, Sebastian Mititelu, Yuzhe Yang
ERGO number: ERGO/FEPS/56029.A2

You are being invited to take part in the above research study. To help you decide whether you would like to take part or not, it is important that you understand why the research is being done and what it will involve. Please read the information below carefully and ask questions if anything is not clear or you would like more information before you decide to take part in this research. You may like to discuss it with others but it is up to you to decide whether or not to take part. If you are happy to participate you will be asked to sign a consent form.

What is the research about?
This study aims to analyse how adopting certain measures while conducting a virtual team meeting with other people would have an impact on the group's mutual level of trust – which would lead to a higher performance. Participants would be asked to submit a video of themselves answering questions about their professional background prior to the meeting starting. This information would be shared with the other participants within the group. We are aiming to assess this approach by making use of a team effectiveness survey post experimentation to record the participants' feedback.

Why have I been asked to participate?
You have been asked to participate because you have expressed interest in joining this study and helping the researchers identify new ways of improving virtual team interactions.

What will happen to me if I take part?
The current project is based on an experiment which is going to be hosted on Microsoft Teams, and shall not last longer than 1 hour. This will involve completing a short survey on team effectiveness after the virtual group meeting. In more detail, after all the participants will have read the Participant Information Sheet and agreed to participate, they will be asked to fill in an online survey on the University of Southampton's wellthlab website portal (whose responses would be associated with a Participant number). Once we had formed experimentation groups, participants will have to log in on the Microsoft Teams portal, prior to the meeting starting, and will be given instructions on how to access our application added to the portal – which will allow them to record videos of themselves answering a set of questions related to their skills and professional expertise. These videos will be displayed inside the Microsoft Teams app for their team members to watch prior to the meeting, after deliberately setting these videos to public. Once they had entered the conference, they will be encouraged to communicate with each other while solving a set of collaborative tasks of logical nature. At the end of this conference, each member will have the opportunity of recording their feedback towards their interaction, while filling a short team effectiveness survey. All this data will be anonymously associated with their participant ID. This would be the end of the experiment.

Are there any benefits in my taking part?
Your participation will help us devise better tools on improving virtual team interactions.

Are there any risks involved?
There are no significant risks associated with the current study beyond those which you might encounter in your day to day life. However, if at any point you feel uncomfortable please let the researcher know immediately.

What data will be collected?
The data that we will be collecting for the purpose of this research will be the result of completing the sign-up, feedback surveys, video-based introduction, the participant's email and potentially the

UNIVERSITY OF Southampton

Microsoft Teams Authentication Token, which will be used upon setting the introduction videos to public for the team members to see, and which is not related to the user's Microsoft Teams credentials. This data will be associated with the participant number, so no personal data will be used when reporting and analysing our findings. Should the participant wish to leave the experiment, a link for their personal data will be kept in order to remove any occurrence of their participation within the study.

Will my participation be confidential?
Your participation and the information we collect about you during the course of the research will be kept strictly confidential.

Only members of the research team and responsible members of the University of Southampton may be given access to data about you for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your data. All of these people have a duty to keep your information, as a research participant, strictly confidential.

Your data will be anonymised and stored on a university password protected computer.

Do I have to take part?
No, it is entirely up to you to decide whether or not to take part. If you decide you want to take part, you will need to sign a consent form to show you have agreed to take part. If you wish to take part in the study, you will have to contact George Muresan by email at gcm1u16@soton.ac.uk.

What happens if I change my mind?
You have the right to change your mind and withdraw at any time without giving a reason and without your participant rights being affected.

What will happen to the results of the research?
Your personal details will remain strictly confidential. Research findings made available in any reports or publications will not include information that can directly identify you without your specific consent.

The results of the study will be used in writing up a research paper, may be included in publications, and may also be used to inform related studies.

Where can I get more information?
If you have any further questions regarding the study, please email George Muresan at gcm1u16@soton.ac.uk.

What happens if there is a problem?
If you have a concern about any aspect of this study, you should speak to the researchers who will do their best to answer your questions.
If you remain unhappy or have a complaint about any aspect of this study, please contact the University of Southampton Research Integrity and Governance Manager (023 8059 5058, rgoinfo@soton.ac.uk).

Data Protection Privacy Notice
The University of Southampton conducts research to the highest standards of research integrity. As a publicly-funded organisation, the University has to ensure that it is in the public interest when we use personally-identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and complete the research project. Under data protection law, 'Personal data' means any information that relates to and is capable of identifying a living individual. The University's data protection policy governing the use of personal

UNIVERSITY OF Southampton

data by the University can be found on its website (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page).

This Participant Information Sheet tells you what data will be collected for this project and whether this includes any personal data. Please ask the research team if you have any questions or are unclear what data is being collected about you.

Our privacy notice for research participants provides more information on how the University of Southampton collects and uses your personal data when you take part in one of our research projects and can be found at http://www.southampton.ac.uk/assets/sharepoint/intranet/ls/Public/Research%20and%20Integrity%20Privacy%20Notice/Privacy%20Notice%20for%20Research%20Participants.pdf

Any personal data we collect in this study will be used only for the purposes of carrying out our research and will be handled according to the University's policies in line with data protection law. If any personal data is used from which you can be identified directly, it will not be disclosed to anyone else without your consent unless the University of Southampton is required by law to disclose it.

Data protection law requires us to have a valid legal reason ('lawful basis') to process and use your Personal data. The lawful basis for processing personal information in this research study is for the performance of a task carried out in the public interest. Personal data collected for research will not be used for any other purpose.

For the purposes of data protection law, the University of Southampton is the 'Data Controller' for this study, which means that we are responsible for looking after your information and using it properly. The University of Southampton will keep identifiable information about you for 1 year after the study has finished after which time any link between you and your information will be removed.

To safeguard your rights, we will use the minimum personal data necessary to achieve our research study objectives. Your data protection rights – such as to access, change, or transfer such information - may be limited, however, in order for the research output to be reliable and accurate. The University will not do anything with your personal data that you would not reasonably expect.

If you have any questions about how your personal data is used, or wish to exercise any of your rights, please consult the University's data protection webpage (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page) where you can make a request using our online form. If you need further assistance, please contact the University's Data Protection Officer (data.protection@soton.ac.uk).

Thank you.
Thank you for taking the time to read the information sheet and considering taking part in the research.

[15.02.2021] [Version 1] **[ERGO/FEPS/56029.A2]**

A.2 Appendix: Problem Solving Tasks

A.2.1 Insight problems

Prisoner: A prisoner was attempting to escape from a tower. He found in his cell a rope which was half long enough to permit him to reach the ground safely. He divided the rope in half and tied the two parts together and escaped. How could he have done this? Explain specifically what he did.

Water lilies: Water lilies double in area every 24 hours. At the beginning of summer there is one water lily on the lake. It takes 60 days for the lake to become completely covered with water lilies. On which day is the lake half covered?

Socks: If you have black socks and brown socks in your drawer, mixed in a ratio of 4 to 5, how many socks will you have to take out to make sure that you have a pair the same color?

A.2.2 Incremental problems

Age: Ann is twice as old as her son. They were both born in June. Ten years ago Ann was three times as old as her son. What are their present ages?

Store: Smith is a butcher and president of the street storekeepers' committee, which also includes the grocer, the baker, and the pharmacist. They all sit around a table.

1. Smith sits on Jones' left.
2. Davis sits at the grocer's right.
3. Bailey, who faces Jones, is not the baker.

Words: Rearrange the following patterns to make familiar words:

1. runghy;
2. flymia;
3. mulcica;
4. dornev;
5. lendraca.

A.3 TDS: Team Effectiveness Process Criteria

The post-experiment questionnaire featured TDS questions rated on a 5-point Likert scale, covering three subdimensions within the Team Effectiveness Process Criteria section: highly inaccurate, inaccurate, neutral, accurate, and highly accurate.

A.3.1 Effort-Related Process

Members demonstrate their commitment to our team by putting in extra effort to help it succeed.

Everyone on this team is motivated to have the team succeed.

Some members of our team do not carry their fair share of the overall workload.

A.3.2 Strategy-Related Process

Our team often comes up with innovative ways of proceeding with the tasks that turn out to be just what is needed.

Our team has a great deal of difficulty actually carrying out the plans we make for how we will proceed with the task.

Our team often falls into mindless routines, without noticing any changes that may have occurred in our situation.

A.3.3 Knowledge and Skill-Related Process

How seriously a member's ideas are taken by others on our team often depends more on who the person is than on how much he or she actually knows.

Members of our team actively share their special knowledge and expertise with one another.

Our team is quite skilled at capturing the lessons that can be learned from our work experiences.

Appendix B

Supporting Materials (Chapter 4)

B.1 Participant Information Sheet

University of Southampton

Participant Information Sheet

Study Title: Examining the Influence of Verbal Cue Awareness on Engagement in Computer-Mediated Communication: A Feedback-Based Approach

Researcher: George Muresan
ERGO number: 82068

You are being invited to take part in the above research study. To help you decide whether you would like to take part or not, it is important that you understand why the research is being done and what it will involve. Please read the information below carefully and ask questions if anything is not clear or you would like more information before you decide to take part in this research. You may like to discuss it with others, but it is up to you to decide whether to take part. If you are happy to participate you will be asked to sign a consent form.

What is the research about?
In this study, we are interested in exploring how people engage in virtual conferences and their experiences during these events. We will ask you questions about your digital social interactions and your interests related to the virtual video conferences. During the conferences, we will observe different aspects of your participation. We want to understand how people interact and their overall experience while interacting with a positively acquainted person on a topic of mutual interest. Your participation will greatly contribute to our understanding of virtual conferences and how they can be improved.

Why have I been asked to participate?
You have been asked to participate because you are part of the University of Southampton community or have expressed interest in the study.

What will happen to me if I take part?

If you choose to participate in this study, you will be asked to complete questionnaires and engage in virtual conferences with another positively acquainted participant. Your involvement will require answering questions about your digital social interactions behaviours and interests, as well as sharing your experiences during the conferences. You will have the opportunity to engage in conversations on topics of mutual interest and interact with the other participant in a virtual setting. Your responses and behaviours during the study will be recorded and analysed for research purposes. It is important to note that your participation is voluntary, and you have the right to withdraw at any time without providing a reason. Your confidentiality and anonymity will be strictly maintained, and any data collected will be used solely for research purposes. By participating, you will contribute to advancing our understanding of social interactions in virtual environments and potentially informing the development of improved communication strategies.

Are there any benefits in my taking part?
Your participation will help us understand how behaviour tracking can be used to help inform skill building techniques for improved digital social interactions.

Are there any risks involved?
There are no significant risks associated with the current study beyond those which you might encounter in your day-to-day life. However, if at any point you feel uncomfortable, please let the researcher know immediately.

Will my participation be confidential?
Your participation and the information we collect about you during the course of the research will be kept strictly confidential.

Only members of the research team and responsible members of the University of Southampton may be given access to data about you for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your data. All of these people have a duty to keep your information, as a research participant, strictly confidential.

Your data will be anonymised and stored on a university password protected computer.

Do I have to take part?
No, it is entirely up to you to decide whether to take part. If you decide you want to take part, you will need to sign a consent form to show you have agreed to take part.
If you wish to take part in the study, you will have to contact George Muresan by email at gcm1u16@soton.ac.uk

What happens if I change my mind?
You have the right to change your mind and withdraw at any time without giving a reason and without your participant rights being affected. If you decide to withdraw, please contact the investigator (George Muresan), by emailing at gcm1u16@soton.ac.uk

If you withdraw from the study prior to the experiment being finalised, the information provided by you during the study will be removed from any sources. If you withdraw from the study after the experiment has finalised, your anonymysed data will remain in the system, albeit to the extent to which your anonymity has not been breached. In case of withdrawal, the withdrawal motive may be recorded for future argumentation on statistics around participant involvement in the study.

What will happen to the results of the research?
Your personal details will remain strictly confidential. Research findings made available in any reports or publications will not include information that can directly identify you without your specific consent.

The results of the study will be used in writing up a research paper, may be included in publications, and may also be used to inform related studies.

Where can I get more information?
If you have any further questions regarding the study, please email George Muresan at gcm1u16@soton.ac.uk

What happens if there is a problem?
If you have a concern about any aspect of this study, you should speak to the researchers who will do their best to answer your questions.
If you remain unhappy or have a complaint about any aspect of this study, please contact the University of Southampton Research Integrity and Governance Manager (023 8059 5058, rgoinfo@soton.ac.uk).

Please contact the investigator by emailing at gcm1u16@soton.ac.uk

Data Protection Privacy Notice
The University of Southampton conducts research to the highest standards of research integrity. As a publicly funded organisation, the University has to ensure that it is in the public interest when we use personally identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and complete the research project. Under data protection law, 'Personal data' means any information that relates to and is capable of identifying a living individual. The University's data protection policy governing the use of personal

University of Southampton

data by the University can be found on its website (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page).

This Participant Information Sheet tells you what data will be collected for this project and whether this includes any personal data. Please ask the research team if you have any questions or are unclear what data is being collected about you.

Our privacy notice for research participants provides more information on how the University of Southampton collects and uses your personal data when you take part in one of our research projects and can be found at http://www.southampton.ac.uk/assets/sharepoint/intranet/ls/Public/Research%20and%20Integrity%20Privacy%20Notice/Privacy%20Notice%20for%20Research%20Participants.pdf

Any personal data we collect in this study will be used only for the purposes of carrying out our research and will be handled according to the University's policies in line with data protection law. If any personal data is used from which you can be identified directly, it will not be disclosed to anyone else without your consent unless the University of Southampton is required by law to disclose it.

Data protection law requires us to have a valid legal reason ('lawful basis') to process and use your Personal data. The lawful basis for processing personal information in this research study is for the performance of a task carried out in the public interest. Personal data collected for research will not be used for any other purpose.

For the purposes of data protection law, the University of Southampton is the 'Data Controller' for this study, which means that we are responsible for looking after your information and using it properly. The University of Southampton will keep identifiable information about you for 10 years after the study has finished after which time any link between you and your information will be removed.

To safeguard your rights, we will use the minimum personal data necessary to achieve our research study objectives. Your data protection rights – such as to access, change, or transfer such information - may be limited, however, in order for the research output to be reliable and accurate. The University will not do anything with your personal data that you would not reasonably expect.

If you have any questions about how your personal data is used, or wish to exercise any of your rights, please consult the University's data protection webpage (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page) where you can make a request using our online form. If you need further assistance, please contact the University's Data Protection Officer (data.protection@soton.ac.uk).

Thank you.

[26.07.2023] [Version 2] [Ergo Number: 82068]

B.2 Study 1

B.2.1 Sign-Up Questionnaire

This section includes the full sign-up questionnaire used in the Engagement Awareness Study. The questionnaire gathers participant information, personality data using the Big Five model, and preferences for discussion topics.

Consent and Participation Details

Please read the Participant Information Sheet before proceeding. By submitting this form, you agree to participate in the experiment, you provide consent and confirm that you have read and understood the information provided.

ERGO Number: 82068

- Email address
- Peer email address (for pairing purposes)
- Relationship with peer (description and duration)
- Participant ID number
- Age group:
  - 18–24
  - 25–34
  - 35–44
  - 45–54
  - 55 and over
- Gender identity:
  - Male
  - Female
  - Other
  - Prefer not to say

Personality Assessment (Big Five Model)

Please indicate your agreement with the following statements:

- I see myself as someone who...
  - Has frequent mood swings
  - Worries about things
  - Seldom feels blue
  - Is relaxed most of the time

- Is quiet around strangers
- Is the life of the party
- Keeps in the background
- Talks to a lot of different people at parties
- Feels little concern for others
- Is not interested in other people's problems
- Sympathises with others' feelings
- Takes time out for others
- Gets chores done right away
- Leaves belongings around
- Often forgets to put things back
- Follows a schedule
- Does not have a good imagination
- Is full of ideas
- Has a rich vocabulary
- Has difficulty understanding abstract ideas

(Each statement is rated: Strongly Disagree, Disagree, Neither, Agree, Strongly Agree)

Conversation Topics

What topics would you be interested in discussing with your chosen peer?

- Technology
- Social Media
- Aviation
- Cooking & Baking
- Exercising & Fitness
- Gardening & Landscaping
- Movies & TV Shows
- Shopping
- Traveling
- Music

- Food
- Sports
- Gaming
- Other: _____

Scheduling

Please propose the times when you and your friend/acquaintance are available to participate in this online experiment (lasting up to one hour):

B.2.2 C1 Post-Experiment Questionnaire

This section presents the post-experiment questionnaire for participants in Condition 1 of the Engagement Awareness Study.

Thank You for Participating in this experiment!
Your input is essential to us. As a final step, please complete this brief questionnaire. To show our appreciation for your time, you will receive an Amazon gift voucher as a token of our thanks.

Participant Details

- Participant ID Number: _____

Section A: Perceived Experience and Changes During the Meeting

Before the experiment...

- How aware were you of the potential for interruptions during your interactions?
- How aware were you of the potential for pauses between you and your peer during the discussions?
- How aware were you of the potential for variations in speaking time distribution between you and your peer?

(Scale: Not at all aware, Slightly aware, Somewhat aware, Moderately aware, Extremely aware)

After the experiment...

- How aware were you of the potential for interruptions during your interactions?
- How aware were you of the potential for pauses between you and your peer during the discussions?
- How aware were you of the potential for variations in speaking time distribution between you and your peer?

(Scale: Not at all aware, Slightly aware, Somewhat aware, Moderately aware, Extremely aware)

Open-ended Questions:

- How socially engaged did you feel during your interactions today? Please describe your level of engagement and what contributed to it.
- Did you notice any changes in your engagement during the second interaction compared to the first? If yes, please describe the changes in detail.

Section B: Perceptions of Feedback

Open-ended Questions:

- How comfortable were you with the information provided after the first interaction? Please elaborate.
- What were your thoughts on the information you received after the first interaction? Specific helpful or unhelpful aspects?
- How do you believe the information affected your engagement during the second interaction?
- How could this information be improved to enhance engagement in future interactions?

Section C: Feedback Type

- Which type of feedback did you prefer, if any? (Choose one):
  - Visual (symbols, images, notifications)
  - Textual (written summary, comments, etc.)

  - No preference

- Please explain why you preferred this type of feedback or why you had no preference.

Section D: Overall Reflections

Open-ended Questions:

- Reflecting on the experiment, what insights have you gained about your communication style or engagement in CMC?
- Any additional comments or suggestions for future research?

B.2.3 C2 Post-Experiment Questionnaire

This section presents the post-experiment questionnaire for participants in Condition 1 of the Engagement Awareness Study.

Thank You for Participating in this experiment!
Your input is essential to us. As a final step, please complete this brief questionnaire. To show our appreciation for your time, you will receive an Amazon gift voucher as a token of our thanks.

Participant Details

- Participant ID Number: _____

Section A: Perceived Experience and Changes During the Meeting

Before the experiment...

- How aware are you of the potential for interruptions during your interactions?
- How aware are you of the potential for pauses between you and your peer during the discussions?

- How aware are you of the potential for variations in speaking time distribution between you and your peer?

(Scale: Not at all aware, Slightly aware, Somewhat aware, Moderately aware, Extremely aware)

After the experiment...

- How aware are you of the potential for interruptions during your interactions?
- How aware are you of the potential for pauses between you and your peer during the discussions?
- How aware are you of the potential for variations in speaking time distribution between you and your peer?

(Scale: Not at all aware, Slightly aware, Somewhat aware, Moderately aware, Extremely aware)

Open-ended Questions:

- How socially engaged did you feel during your interactions today? Please describe your level of engagement and what contributed to it.
- Did you notice any changes in your engagement during the second interaction compared to the first? If yes, please describe the changes in detail.

Section B: Perceptions of Feedback

Open-ended Questions:

- How comfortable were you with the information provided after the first interaction? Please elaborate on your comfort level and any thoughts or feelings it evoked.
- What were your thoughts of the information you received after the first interaction? Please describe any specific aspects that you found particularly helpful or not helpful.
- How do you believe that receiving that information after the first interaction affected your engagement during the second interaction? Please explain your perspective.
- In your opinion, how could this information be further improved to enhance engagement in future interactions? Please provide suggestions.

Section C: Feedback Type

- Which type of feedback did you prefer, if any? (Choose one):
  - Visual (symbols, images, notifications)
  - Textual (written summary, comments, etc.)
  - No preference
- Please explain why you preferred this type of feedback or why you had no preference.

Section D: Real-Time Feedback

Open-ended Questions:

- How did you feel about receiving real-time feedback during the second interaction? Please share your thoughts and any ways it affected your communication.
- How would you compare receiving real-time feedback, versus the information you received in between interactions?

Section E: Overall Reflections

Open-ended Questions:

- Reflecting on the entire experiment, including both interactions and the feedback received, what insights have you gained about your communication style or engagement in computer-mediated communication?
- Is there anything else you would like to share regarding your experience in this study or any suggestions for future research in this area?

B.2.4 List: Topics of Discussion

Each topic listed below includes a set of curated, interesting talking points that participants may use to guide discussion. These are based on fun facts, news headlines, and real-world insights.

Technology

- NASA has received a signal from 10 million miles away.
- ChatGPT is the fastest platform to gather 1 billion users, in less than a year.
- Samsung is 38 years older than Apple.
- Some people are afraid of technology.
- Kids that are on social media for 1 hour a day have less chance of being happy.
- Robot laws are being put into place in the European Union.

Social Media

- YouTube now loads content slower for people that are detected to use AdBlocks.
- TikTok is considered 'most popular source for news' among teenagers.
- Facebook might actually benefit mental health, new study suggests.
- Instagram to use video selfies to allow UK users to 'prove their age'.
- The average internet user has 8.6 social media accounts.
- Instagram reports 50% of users are more interested in a brand when they see ads for it on Instagram.

Aviation

- NASA develops quiet supersonic aircraft for public testing in 2025.
- Electric aircraft trials are underway across regional UK airports.
- Boom Supersonic aims to launch Concorde-successor test flights in the next year or so.
- Airlines push for sustainable jet fuel amid climate goals.
- The world's shortest commercial flight lasts just 57 seconds - between two Scottish islands.
- Drone delivery expands into residential urban areas in 2024.

Cooking & Baking

- Different coloured potatoes are used for different kind of dishes.
- There are female and male peppers, which you can identify based on shape.
- Master Chef is a British show, and it's present in 60 countries.
- The world's oldest oven was discovered in Croatia in 2014 dating back 6500 years ago.
- Real vanilla is very expensive; most supermarket vanilla is synthetic.
- If you need to cool down your drink, don't stir it.

Exercising & Fitness

- Arnold Schwarzenegger recommends against using phones at the gym.
- The busiest days of the year in a gym are early January.
- Exercising 3 times a week for 45 minutes can help prevent signs of ageing.
- Total body workouts and workouts by muscle group are equally effective.
- People with obesity burn less energy during the day.
- Walking can enhance cognitive function in older adults.

Gardening & Landscaping

- A type of grass exists that never grows taller than a few centimeters.
- Butterflies might be more attracted to your weeds than your flowers.
- A little baking soda can help you grow sweeter tomatoes.
- One hour of weeding burns 300 calories.
- Trees block noise by reducing sound waves.
- Dubai Miracle Garden is the largest in the world with over 60 million flowers.

Movies & TV Shows

- Hollywood faced its biggest strike ever in 2023.
- Game of Thrones was the most pirated show for six consecutive years.
- The owls in Harry Potter were trained to carry letters.
- Barbie and Oppenheimer releases marked a major cultural event.
- The snow in the original Wizard of Oz was made of asbestos.
- Real Life Squid Game competitors complained about filming conditions.

Shopping

- Real fur was found labelled as fake on major retail sites.
- ASOS profited massively from lockdown spending.
- France considered banning Black Friday to curb overconsumption.
- Samsung is 38 years older than Apple.
- Women are more likely to notice offers while shopping.
- Some people use shopping as a coping strategy.

Traveling

- Turkey is now Europe's most visited country.
- The UK is rolling out an Electronic Travel Authorisation (ETA) scheme.
- Saudi Arabia is building futuristic cities: The Line and The Cube.
- Australia is employing goats in railway stations.
- Iceland issued travel warnings due to potential volcanic eruptions.
- Berlin will introduce a driverless magnetic levitation train.

Music

- Britney Spears was in a conservatorship for 13 years.
- Music helps plants grow faster.
- Michael Jackson once tried to buy Marvel Comics.
- "Wannabe" by the Spice Girls is considered the catchiest song of all time.
- "Jingle Bells" was originally a Thanksgiving song.
- Babies can hear music inside the womb.

Food

- Skittles is being sued for containing harmful ingredients.
- A Mediterranean diet may help improve sleep.
- The French baguette received UNESCO heritage status.
- Horse meat and foie gras are banned in the U.S.
- Taco Bell is adding vegan burritos to its menu.
- Cranberries may benefit heart health.

Sports

- Swimming and volleyball train all major muscle groups.
- Squash, skateboarding, surfing, and rock climbing are recent Olympic sports.
- Quidditch, from Harry Potter, is played in real life.
- Golf was the first sport played on the moon.
- Paris aims to make the River Seine swimmable.
- Football is the most popular sport globally.

Gaming

- Pokemon GO encouraged physical activity worldwide.
- CS:GO, Minecraft, and Fortnite remain extremely popular.
- Simlish, the Sims' language, combines many real languages.
- GTA 6 may cost around £120 at launch.
- One Minecraft world is five times Earth's diameter.
- Mario is the best-selling game series according to Guinness World Records.

B.3 Study 2

B.3.1 Sign-Up Questionnaire

This section includes the sign-up questionnaires used in Study 2 of the Engagement Awareness Study. Two versions were provided, depending on whether participants were returning from a previous study or new to the experiment.

Returning Participants

Please read the Participant Information Sheet before proceeding. By submitting this form, you agree to participate in the experiment, provide consent, and confirm that you have read and understood the information provided in the Participant Information Sheet.

ERGO Number: 82068

- Participant ID number
- Email address
- Peer email address (for pairing purposes)
- Age group:
  - 18–24
  - 25–34
  - 35–44
  - 45–54

  - 55 and over

- Gender identity:
  - Male
  - Female
  - Other
  - Prefer not to say

Scheduling

Please propose the times when you and your friend/acquaintance are available to participate in this online experiment (lasting up to one hour):

New Participants

Please read the Participant Information Sheet before proceeding. By submitting this form, you agree to participate in the experiment, provide consent, and confirm that you have read and understood the information provided in the Participant Information Sheet.

ERGO Number: 82068

- Email address
- Peer email address (for pairing purposes)
- Relationship description with peer (how well and how long they've known each other)
- Participant ID number
- Age group:
  - 18–24
  - 25–34
  - 35–44
  - 45–54
  - 55 and over
- Gender identity:
  - Male

  - Female
  - Other
  - Prefer not to say

Personality Assessment (Big Five Model)

Please indicate how much you agree with each of the following statements:

- I see myself as someone who...
  - Has frequent mood swings
  - Worries about things
  - Seldom feels blue
  - Is relaxed most of the time
  - Is quiet around strangers
  - Is the life of the party
  - Keeps in the background
  - Talks to a lot of different people at parties
  - Feels little concern for others
  - Is not interested in other people's problems
  - Sympathizes with others' feelings
  - Takes time out for others
  - Gets chores done right away
  - Leaves belongings around
  - Often forgets to put things back in their proper place
  - Follows a schedule
  - Does not have a good imagination
  - Is full of ideas
  - Has a rich vocabulary
  - Has difficulty understanding abstract ideas

(Response scale: Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, Strongly Agree)

Scheduling

Please propose the times when you and your friend/acquaintance are available to participate in this online experiment (lasting up to one hour):

B.3.2 Mid-Experiment Questionnaire

This subsection contains the modified Interpersonal Communication Satisfaction Inventory (ICSI) used at the mid-experiment stage to evaluate participants' communication experience during the first interaction.

Questionnaire

Thank you for participating in this experiment! We are halfway through. Before proceeding to the next step, please complete this brief questionnaire.

Please write your given Participant ID below.

Please rate the following statements based on your experience during the first meeting:

- The other person let me know that I was communicating effectively.
- Nothing was accomplished.
- I would like to have another conversation like this one.
- I was very dissatisfied with the conversation/communication.
- I had something new to improve communication.
- The other person showed that he/she understood what I said.
- I was very satisfied with the conversation.
- The person expressed a lot of interest in what I had to say.
- I did NOT enjoy the conversation.
- The other person did NOT provide support for what he/she was saying.
- I felt I could communicate about anything with the other person.

- We each got to communicate what we wanted.
- The conversation/communication flowed smoothly.
- The other person frequently said things which added little to the conversation.
- We talked about something I was NOT interested in.
- I felt the conversation was balanced in terms of contribution from each of us.
- The conversation felt natural and engaging.
- I was able to express my thoughts freely and completely.

Please rate each statement using a 7-point Likert scale: Strongly Disagree, Disagree, Slightly Disagree, Neutral, Slightly Agree, Agree, Strongly Agree.

B.3.3 Returning Participants: Post-Experiment Questionnaire

This subsection presents the final questionnaire completed by returning participants at the conclusion of Study 2. It assessed their perceived engagement, communication satisfaction, and perceptions of the real-time feedback system, as well as comparisons to their previous experience in Study 1.

Thank You for Participating in this experiment!
Your input is essential to us. As a final step, please complete this brief questionnaire. To show our appreciation for your time, you will receive a £15 incentive as a token of our thanks.

Participant Details

- Participant ID Number: _____

Section A: Perceived Experience and Changes During the Meeting

Before the experiment...

- How aware are you of the potential for interruptions during your interactions?

- How aware are you of the potential for pauses between you and your peer during the discussions?
- How aware are you of the potential for variations in speaking time distribution between you and your peer?

(Scale: Not at all aware, Slightly aware, Somewhat aware, Moderately aware, Extremely aware)

After the experiment...

- How aware are you of the potential for interruptions during your interactions?
- How aware are you of the potential for pauses between you and your peer during the discussions?
- How aware are you of the potential for variations in speaking time distribution between you and your peer?

(Scale: Not at all aware, Slightly aware, Somewhat aware, Moderately aware, Extremely aware)

Open-ended Questions:

- How socially engaged did you feel during your interactions today? Please describe your level of engagement and what contributed to it.
- Did you notice any changes in your engagement during the second interaction compared to the first? If yes, please describe the changes in detail.

Section B: Communication Satisfaction (ICSI)

Please rate the following statements based on your experience during the second meeting:

- The other person let me know that I was communicating effectively.
- Nothing was accomplished.
- I would like to have another conversation like this one.
- I was very dissatisfied with the conversation/communication.
- I had something new to improve communication.
- The other person showed that he/she understood what I said.
- I was very satisfied with the conversation.

- The person expressed a lot of interest in what I had to say.
- I did NOT enjoy the conversation.
- The other person did NOT provide support for what he/she was saying.
- I felt I could communicate about anything with the other person.
- We each got to communicate what we wanted.
- The conversation/communication flowed smoothly.
- The other person frequently said things which added little to the conversation.
- We talked about something I was NOT interested in.
- I felt the conversation was balanced in terms of contribution from each of us.
- The conversation felt natural and engaging.
- I was able to express my thoughts freely and completely.

Please rate each statement using a 7-point Likert scale: Strongly Disagree, Disagree, Slightly Disagree, Neutral, Slightly Agree, Agree, Strongly Agree.

Section C: Perceptions of Feedback

Open-ended Questions:

- How comfortable were you with the information provided during the second interaction? Please elaborate.
- What were your thoughts on the information received during the second interaction? Mention any helpful or unhelpful aspects.
- How do you believe the feedback affected your engagement during the second interaction?
- How could this information be improved to enhance engagement in future interactions?

Section D: Feedback Type

- Which type(s) of feedback did you prefer (choose as many as applicable)?
  - Sliders (notifications sliding in from the sides)
  - Glowing edges (red or blue edge indicators)
  - Counters (round visual elements tracking interruptions or pauses)
  - Race-track visualisation (central speaking balance tracker)
- Please explain your preferences or reasons for not having a preference.

Section E: Returning Participants

Open-ended Questions:

- Compared to your previous experience with feedback, how did the new automated approach differ?
- Did the new feedback system affect your stress or discomfort levels during the session? Please elaborate.

Section F: Overall Reflections

Open-ended Questions:

- What insights did you gain about your communication style or engagement?
- Any final comments or suggestions for future research?

B.3.4 New Participants: Post-Experiment Questionnaire

This subsection presents the post-experiment questionnaire completed by new participants in Study 2. It explores their engagement awareness, satisfaction with communication, and reflections on the real-time feedback system used during the second interaction.

Thank You for Participating in this experiment!
Your input is essential to us. As a final step, please complete this brief questionnaire. To show our appreciation for your time, you will receive a £15 incentive as a token of our thanks.

Participant Details

- Participant ID Number: _____

Section A: Perceived Experience and Changes During the Meeting

Before the experiment...

- How aware are you of the potential for interruptions during your interactions?
- How aware are you of the potential for pauses between you and your peer during the discussions?
- How aware are you of the potential for variations in speaking time distribution between you and your peer?

(Scale: Not at all aware, Slightly aware, Somewhat aware, Moderately aware, Extremely aware)

After the experiment...

- How aware are you of the potential for interruptions during your interactions?
- How aware are you of the potential for pauses between you and your peer during the discussions?
- How aware are you of the potential for variations in speaking time distribution between you and your peer?

(Scale: Not at all aware, Slightly aware, Somewhat aware, Moderately aware, Extremely aware)

Open-ended Questions:

- How socially engaged did you feel during your interactions today? Please describe your level of engagement and what contributed to it.
- Did you notice any changes in your engagement during the second interaction compared to the first? If yes, please describe the changes in detail.

Section B: Communication Satisfaction (ICSI)

Please rate the following statements based on your experience during the second meeting:

- The other person let me know that I was communicating effectively.

- Nothing was accomplished.
- I would like to have another conversation like this one.
- I was very dissatisfied with the conversation/communication.
- I had something new to improve communication.
- The other person showed that he/she understood what I said.
- I was very satisfied with the conversation.
- The person expressed a lot of interest in what I had to say.
- I did NOT enjoy the conversation.
- The other person did NOT provide support for what he/she was saying.
- I felt I could communicate about anything with the other person.
- We each got to communicate what we wanted.
- The conversation/communication flowed smoothly.
- The other person frequently said things which added little to the conversation.
- We talked about something I was NOT interested in.
- I felt the conversation was balanced in terms of contribution from each of us.
- The conversation felt natural and engaging.
- I was able to express my thoughts freely and completely.

Please rate each statement using a 7-point Likert scale: Strongly Disagree, Disagree, Slightly Disagree, Neutral, Slightly Agree, Agree, Strongly Agree.

Section C: Perceptions of Feedback

Open-ended Questions:

- How comfortable were you with the information provided during the second interaction? Please elaborate.
- What were your thoughts on the information received during the second interaction? Mention any helpful or unhelpful aspects.
- How do you believe the feedback affected your engagement during the second interaction?
- How could this information be improved to enhance engagement in future interactions?

Section D: Feedback Type

- Which type(s) of feedback did you prefer (choose as many as applicable)?
  - Sliders (notifications sliding in from the sides)
  - Glowing edges (red or blue edge indicators)
  - Counters (round visual elements tracking interruptions or pauses)
  - Race-track visualisation (central speaking balance tracker)
- Please explain your preferences or reasons for not having a preference.

Section E: Overall Reflections

Open-ended Questions:

- What insights did you gain about your communication style or engagement?
- Any final comments or suggestions for future research?

B.3.5 Collaborative Role-Play Games

This subsection outlines the collaborative role-playing scenarios used during both experimental sessions. These games were designed to promote natural interaction, shared decision-making, and conversational flow under varying constraints and objectives.

First Meeting Games

- **Desert Island Survival** *Setting:* Stranded on a deserted island. *Roles:* Resource Gatherer and Shelter Builder. *Objective:* Survive until rescue. *Challenges:* Limited resources, wild animals, weather conditions. *Expected Outcome:* Effective resource management, building a durable shelter, and devising a rescue plan.
- **Pirate Ship Exercise** *Setting:* Life on a pirate ship searching for treasure. *Roles:* Captain and Navigator. *Objective:* Find the treasure and manage the crew. *Challenges:* Navigational hazards, resource management, crew conflicts. *Expected Outcome:* Successful treasure hunt and effective team management.

- **City Planning** *Setting:* Designing a new urban area. *Roles:* Urban Planner and Environmental Specialist. *Objective:* Create a balanced and sustainable city. *Challenges:* Budget constraints, environmental impact, community needs. *Expected Outcome:* A well-planned city layout that balances different needs and promotes sustainability.

Practice Game

- **Catapult to Success** *Setting:* Building a functional catapult. *Roles:* Designer and Tester. *Objective:* Construct a catapult that can hit a target accurately. *Challenges:* Limited materials, engineering constraints, testing phases. *Expected Outcome:* A working catapult and refined problem-solving skills.

Second Meeting Games

- **Zombie Apocalypse** *Setting:* Surviving a zombie outbreak. *Roles:* Survivalist and Medic. *Objective:* Secure a safe location and find supplies. *Challenges:* Zombie attacks, resource scarcity, group dynamics. *Expected Outcome:* Establishing a safe zone and securing necessary supplies through strategic planning.
- **Space Mission** *Setting:* A mission to Mars. *Roles:* Mission Commander and Scientist. *Objective:* Complete the mission objectives and return safely. *Challenges:* Equipment malfunctions, scientific experiments, resource shortages. *Expected Outcome:* Mission success and enhanced collaboration under pressure.
- **Pirate Ship Exercise** *Setting:* Life on a pirate ship searching for treasure. *Roles:* Captain and Navigator. *Objective:* Find the treasure and manage the crew. *Challenges:* Navigational hazards, resource management, crew conflicts. *Expected Outcome:* Successful treasure hunt and effective team management.

References

Emre Can Acikgoz, Cheng Qian, Hongru Wang, Vardhan Dongre, Xiusi Chen, Heng Ji, Dilek Hakkani-Tür, and Gokhan Tur. A Desideratum for Conversational Agents: Capabilities, Challenges, and Future Directions, April 2025. URL http://arxiv.org/abs/2504.16939.

Shikha Agarwal. The Profound Impact of Virtual Communication Technologies on Team Collaboration in the Contemporary Work Environment. 10(1).

Anukrati Agrawal, Michelle Boese, and Saonee Sarker. A Review of the HCI Literature in IS: The Missing Links of Computer-mediated Communication, Culture, and Interaction. *AMCIS 2010 Proceedings*, August 2010. URL https://aisel.aisnet.org/amcis2010/523.

Yair Aharoni and Lilach Nachum. *Globalization of Services: Some Implications for Theory and Practice*. Routledge Studies in International Business and the World Economy. Taylor & Francis, 2000. ISBN 978-1-134-73637-9. URL https://books.google.ca/books?id=vizPl79DKrQC.

Noa Aharony. The use of deep and surface learning strategies among students learning English as a foreign language in an Internet environment. *British Journal of Educational Psychology*, 76(4):851–866, December 2006. ISSN 0007-0998, 2044-8279. . URL https://bpspsychub.onlinelibrary.wiley.com/doi/10.1348/000709905X79158.

Karan Ahuja, Vivian Shen, Cathy Mengying Fang, Nathan Riopelle, Andy Kong, and Chris Harrison. ControllerPose: Inside-Out Body Capture with VR Controller Cameras. In *CHI Conference on Human Factors in Computing Systems*, pages 1–13, New Orleans LA USA, April 2022. ACM. ISBN 978-1-4503-9157-3. . URL https://dl.acm.org/doi/10.1145/3491102.3502105.

Ahmad Alaiad, Yazan Alnsour, and Mohammad Alsharo. Virtual Teams: Thematic Taxonomy, Constructs Model, and Future Research Directions. *IEEE Transactions on Professional Communication*, 62(3):211–238, September 2019. ISSN 1558-1500. . Conference Name: IEEE Transactions on Professional Communication.

Anne Alitolppa-Niitamo. *The Icebreakers: Somali-speaking youth in metropolitan Helsinki with a focus on the context of formal education*. Number 42/2004 in Publications of the Population Research Institute. Series D. Population Research Institute, the Family Federation of Finland, Helsinki, 2004. ISBN 978-951-9450-02-5. OCLC: ocm56013734.

Shoshana Altschuller and Raquel Benbunan-Fich. The pursuit of trust in Ad hoc virtual teams: How much electronic portrayal is too much? *European Journal of Information Systems*, 22(6):619–636, 2013. .

Josh Andres, m. c. schraefel, Rakesh Patibanda, and Florian'Floyd' Mueller. Future inbodied: A framework for inbodied interaction design. In *Proceedings of the Fourteenth International Conference on Tangible, Embedded, and Embodied Interaction*, pages 885–888, 2020.

Michael Argyle and Janet Dean. Eye-contact, distance and affiliation. *Sociometry*, pages 289–304, 1965. URL https://www.jstor.org/stable/2786027. Publisher: JSTOR.

Arthur Aron, Christina C. Norman, Elaine N. Aron, Colin McKenna, and Richard E. Heyman. Couples' shared participation in novel and arousing activities and experienced relationship quality. *Journal of Personality and Social Psychology*, 78(2):273–284, 2000. ISSN 1939-1315. . Place: US Publisher: American Psychological Association.

Bon Adriel Aseniero, Marios Constantinides, Sagar Joglekar, Ke Zhou, and Daniele Quercia. MeetCues: Supporting online meetings experience. In *2020 IEEE Visualization Conference (VIS)*, pages 236–240. IEEE, 2020. URL https://ieeexplore.ieee.org/abstract/document/9331310/.

Jacob Assmann and Julia Gallenkamp. Communication and Leadership Trustworthiness in Virtual Teams: An Empirical Comparison of the US and China. In *2009 42nd Hawaii International Conference on System Sciences*, pages 1–10, January 2009. . URL https://ieeexplore.ieee.org/abstract/document/4755372. ISSN: 1530-1605.

Mirjam Augstein, Thomas Neumayr, Johannes Schönböck, and Carrie Kovacs. Remote Persons Are Closer Than They Appear: Home, Team and a Lockdown. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, CHI '23, pages 1–25, New York, NY, USA, April 2023. Association for Computing Machinery. ISBN 978-1-4503-9421-5. . URL https://dl.acm.org/doi/10.1145/3544548.3580989.

Tommi Auvinen, Iiris Aaltio, and Kirsimarja Blomqvist. Constructing leadership by storytelling – the meaning of trust and narratives. *Leadership & Organization Development Journal*, 34(6):496–514, January 2013. ISSN 0143-7739. . URL https://doi.org/10.1108/LODJ-10-2011-0102. Publisher: Emerald Group Publishing Limited.

Jeremy Bailenson. Nonverbal overload: A theoretical argument for the causes of Zoom fatigue. 2021. URL https://assets.pubpub.org/3xtduwvl/21614092702823.pdf. Publisher: PubPub.

Jeremy Bailenson, Nick Yee, Dan Merget, and Ralph Schroeder. The effect of behavioral realism and form realism of real-time avatar faces on verbal disclosure, nonverbal disclosure, emotion recognition, and copresence in dyadic interaction. *Presence: Teleoperators and Virtual Environments*, 15(4):359–372, 2006. URL https://direct.mit.edu/pvar/article-abstract/15/4/359/18611. Publisher: MIT Press One Rogers Street, Cambridge, MA 02142-1209, USA journals-info ....

Jeremy Bailenson, Yee Nick, Blascovich Jim, Beall Andrew, Lundblad Nicole, and Michael Jin. The Use of Immersive Virtual Reality in the Learning Sciences: Digital Transformations of Teachers, Students, and Social Context. *Journal of the Learning Sciences*, 17(1):102–141, February 2008. ISSN 1050-8406. . URL https://doi.org/10.1080/10508400701793141. Publisher: Routledge _eprint: https://doi.org/10.1080/10508400701793141.

Roger Bakeman and Stephen Beck. The size of informal groups in public. *Environment and Behavior*, 6(3):378, 1974. Publisher: Sage Publications.

John A. Bargh, Katelyn Y. A. McKenna, and Grainne M. Fitzsimons. Can You See the Real Me? Activation and Expression of the "True Self" on the Internet. *Journal of Social Issues*, 58(1):33–48, 2002. ISSN 1540-4560. . URL https://onlinelibrary.wiley.com/doi/abs/10.1111/1540-4560.00247. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/1540-4560.00247.

Murray R. Barrick, Bret H. Bradley, Amy L. Kristof-Brown, and Amy E. Colbert. The Moderating Role of Top Management Team Interdependence: Implications for Real Teams and Working Groups. *Academy of Management Journal*, 50(3):544–557, June 2007. ISSN 0001-4273, 1948-0989. . URL http://journals.aom.org/doi/10.5465/amj.2007.25525781.

Chiara Basile, Serena Lecce, and Floris Tijmen van Vugt. Synchrony during online encounters affects social affiliation and theory of mind but not empathy. *Frontiers in psychology*, 13:886639, 2022. URL https://www.frontiersin.org/articles/10.3389/fpsyg.2022.886639/full. Publisher: Frontiers Media SA.

Janet B. Bavelas, Linda Coates, and Trudy Johnson. Listeners as co-narrators. *Journal of personality and social psychology*, 79(6):941, 2000. URL https://psycnet.apa.org/record/2000-16701-007. Publisher: American Psychological Association.

Geoffrey W. Beattie. Interruption in conversational interaction, and its relation to the sex and status of the interactants*. *Linguistics*, 19(1-2), 1981. ISSN 0024-3949, 1613-396X. . URL https://www.degruyter.com/document/doi/10.1515/ling.1981.19.1-2.15/html.

Howard Becker and Ruth Hill Useem. Sociological analysis of the dyad. *American Sociological Review*, 7(1):13–26, 1942. Publisher: JSTOR.

Charles R. Berger and Richard J. Calabrese. Some Explorations in Initial Interaction and Beyond: Toward a Developmental Theory of Interpersonal Communication. *Human Communication Research*, 1(2):99–112, December 1975. ISSN 0360-3989. . URL https://doi.org/10.1111/j.1468-2958.1975.tb00258.x.

Gregory R. Berry. Can Computer-Mediated Asynchronous Communication Improve Team Processes and Decision Making? Learning From the Management Literature. *The Journal of Business Communication (1973)*, 43(4):344–366, October 2006. ISSN 0021-9436. . URL https://journals.sagepub.com/action/showAbstract. Publisher: SAGE Publications.

David Beyea, Chaeyun Lim, Alex Lover, Maxwell Foxman, Rabindra Ratan, and Alex Leith. Zoom fatigue in review: A meta-analytical examination of video-conferencing fatigue's antecedents. *Computers in Human Behavior Reports*, 17: 100571, 2025. URL https://www.sciencedirect.com/science/article/pii/S2451958824002045. Publisher: Elsevier.

Timothy Bickmore and Justine Cassell. Relational agents: a model and implementation of building user trust. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pages 396–403, Seattle Washington USA, March 2001. ACM. ISBN 978-1-58113-327-1. . URL https://dl.acm.org/doi/10.1145/365024.365304.

Timothy Bickmore, Schulman , Daniel, , and Langxuan Yin. Maintaining Engagement in Long-Term Interventions with Relational Agents. *Applied Artificial Intelligence*, 24(6):648–666, July 2010. ISSN 0883-9514. . URL https://doi.org/10.1080/08839514.2010.492259. Publisher: Taylor & Francis _eprint: https://doi.org/10.1080/08839514.2010.492259.

Frank Biocca, Chad Harms, and Judee K. Burgoon. Toward a more robust theory and measure of social presence: Review and suggested criteria. *Presence: Teleoperators & virtual environments*, 12(5):456–480, 2003. URL https://direct.mit.edu/pvar/article-abstract/12/5/456/58921. Publisher: MIT press One Rogers Street, Cambridge, MA 02142-1209, USA journals-info ....

Ray L. Birdwhistell. *Kinesics and context: Essays on body motion communication*. University of Pennsylvania press, 2010. URL https://books.google.com/books?hl=en&lr=&id=FZLJMmJlDBIC&oi=fnd&pg=PP2&dq=Birdwhistell,+R.+L.+(1970).+Kinesics+and+Context:+Essays+on+Body+Motion+Communication.+Philadelphia,+PA:+University+of+Pennsylvania+Press.&ots=Th2m-iVhqL&sig=avbtBwzNRQ6u6r0vX5I37hFEjZg.

Béla Birkás, Milena Dzhelyova, Beatrix Lábadi, Tamás Bereczkei, and David Ian Perrett. Cross-cultural perception of trustworthiness: The effect of ethnicity features on evaluation of faces' observed trustworthiness across four samples. *Personality*

and Individual Differences, 69:56–61, 2014. URL https://www.sciencedirect.com/science/article/pii/S0191886914002967. Publisher: Elsevier.

Graham D. Bodie and Susanne M. Jones. The Nature of Supportive Listening II: The Role of Verbal Person Centeredness and Nonverbal Immediacy. *Western Journal of Communication*, 76(3):250–269, May 2012. ISSN 1057-0314, 1745-1027. . URL http://www.tandfonline.com/doi/abs/10.1080/10570314.2011.651255.

Graham D. Bodie, Brant R. Burleson, and Susanne M. Jones. Explaining the Relationships among Supportive Message Quality, Evaluations, and Outcomes: A Dual-Process Approach. *Communication Monographs*, 79(1):1–22, March 2012. ISSN 0363-7751, 1479-5787. . URL http://www.tandfonline.com/doi/abs/10.1080/03637751.2011.646491.

Dan Bohus and Eric Horvitz. Multiparty turn taking in situated dialog: Study, lessons, and directions. In *Proceedings of the SIGDIAL 2011 Conference*, pages 98–109, 2011. URL https://aclanthology.org/W11-2013.pdf.

Julie E. Boland, Pedro Fonseca, Ilana Mermelstein, and Myles Williamson. Zoom disrupts the rhythm of conversation. *Journal of Experimental Psychology: General*, 151(6): 1272, 2022. URL https://psycnet.apa.org/record/2022-02247-001. Publisher: American Psychological Association.

Bryan L Bonner, Michael R Baumann, and Reeshad S Dalal. The effects of member expertise on group decision-making and performance. *Organizational Behavior and Human Decision Processes*, 88(2):719–736, July 2002. ISSN 0749-5978. . URL https://www.sciencedirect.com/science/article/pii/S0749597802000109.

Jared Borup, Richard E. West, and Charles E. Graham. Improving online social presence through asynchronous video. *The Internet and Higher Education*, Volume 15(Issue): 195–203, June 2012. URL https://doi.org/10.1016/j.iheduc.2011.11.001.

Nathan Bos, Judy Olson, Darren Gergle, Gary Olson, and Zach Wright. Effects of four computer-mediated communications channels on trust development. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pages 135–140, Minneapolis Minnesota USA, April 2002. ACM. ISBN 978-1-58113-453-7. . URL https://dl.acm.org/doi/10.1145/503376.503401.

Virginia Braun and Victoria Clarke. Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4):589–597, August 2019. ISSN 2159-676X, 2159-6778. . URL https://www.tandfonline.com/doi/full/10.1080/2159676X.2019.1628806.

Christina Breuer, Joachim Hüffmeier, and Guido Hertel. Does trust matter more in virtual teams? A meta-analysis of trust and team effectiveness considering virtuality and documentation as moderators. *Journal of Applied Psychology*, 101(8):

1151, 2016. URL https://psycnet.apa.org/journals/apl/101/8/1151.html?uid=2016-25877-001. Publisher: American Psychological Association.

Christina Breuer, Joachim Hüffmeier, Frederike Hibben, and Guido Hertel. Trust in teams: A taxonomy of perceived trustworthiness factors and risk-taking behaviors in face-to-face and virtual teams. *Human Relations*, 73(1):3–34, January 2020. ISSN 0018-7267. . URL https://doi.org/10.1177/0018726718818721. Publisher: SAGE Publications Ltd.

Buffer. 2023 State Of Remote Work, 2023. URL https://buffer.com/state-of-remote-work/2023.

Hancheng Cao, Chia-Jung Lee, Shamsi Iqbal, Mary Czerwinski, Priscilla N Y Wong, Sean Rintel, Brent Hecht, Jaime Teevan, and Longqi Yang. Large Scale Analysis of Multitasking Behavior During Remote Meetings. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, pages 1–13, Yokohama Japan, May 2021. ACM. ISBN 978-1-4503-8096-6. . URL https://dl.acm.org/doi/10.1145/3411764.3445243.

Traci Carte and Laku Chidambaram. A capabilities-based theory of technology deployment in diverse teams: Leapfrogging the pitfalls of diversity and leveraging its potential with collaborative technology. *Journal of the Association for Information Systems*, 5(11):4, 2004. URL https://aisel.aisnet.org/jais/vol5/iss11/4/.

Wayne F. Cascio. Managing a virtual workplace. *Academy of Management Perspectives*, 14(3):81–90, August 2000. ISSN 1558-9080. . URL https://journals.aom.org/doi/abs/10.5465/ame.2000.4468068. Publisher: Academy of Management.

Justine Cassell. Embodied Conversational Agents: Representation and Intelligence in User Interfaces. *AI Magazine*, 22(4):67–67, December 2001. ISSN 2371-9621. . URL https://ojs.aaai.org/aimagazine/index.php/aimagazine/article/view/1593. Number: 4.

Rebecca L. Chae, Hyojin Lee, and Eunsoo Kim. The Effects of Avatar Human-Likeness on Psychological Closeness in Virtual-Reality. *Psychology & Marketing*, 42(4):1132–1145, 2025. ISSN 1520-6793. . URL https://onlinelibrary.wiley.com/doi/abs/10.1002/mar.22168. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/mar.22168.

Wei-Yu Chang, Ming-Chang Wu, and Shu-Wen Lin. The Effects of Asynchronous Cross-cultural Communication on EFL University Students' Writing Performance and Motivation. *Journal of Language and Education*, 10(1 (37)):35–48, 2024. URL https://shorturl.at/3RnVm. Publisher: ....

Maria Charalampous, Christine A. Grant, Carlo Tramontano, and Evie Michailidis. Systematically reviewing remote e-workers' well-being at work: a multidimensional approach. *European Journal of Work and Organizational Psychology*, 28(1):51–73, January 2019. ISSN 1359-432X, 1464-0643. . URL https://www.tandfonline.com/doi/full/10.1080/1359432X.2018.1541886.

Xinyue Chen, Lev Tankelevitch, Rishi Vanukuru, Ava Elizabeth Scott, Payod Panda, and Sean Rintel. Are We On Track? AI-Assisted Active and Passive Goal Reflection During Meetings. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems*, pages 1–22, Yokohama Japan, April 2025a. ACM. ISBN 9798400713941. . URL https://dl.acm.org/doi/10.1145/3706598.3714052.

Xinyue Chen, Nathan Yap, Xinyi Lu, Aylin Gunal, and Xu Wang. MeetMap: Real-Time Collaborative Dialogue Mapping with LLMs in Online Meetings. *Proceedings of the ACM on Human-Computer Interaction*, 9(2):1–35, May 2025b. ISSN 2573-0142. . URL https://dl.acm.org/doi/10.1145/3711030.

Ying-Hueih Chen, Tzu-Pei Lin, and David C. Yen. How to facilitate inter-organizational knowledge sharing: The impact of trust. *Information & Management*, 51(5):568–578, July 2014. ISSN 0378-7206. . URL https://www.sciencedirect.com/science/article/pii/S0378720614000408.

Prerna Chikersal, Maria Tomprou, Young Ji Kim, Anita Williams Woolley, and Laura Dabbish. Deep structures of collaboration: Physiological correlates of collective intelligence and group satisfaction. In *Proceedings of the 2017 ACM conference on computer supported cooperative work and social computing*, pages 873–888, 2017.

Herbert H. Clark. *Using Language*. Cambridge University Press, May 1996. ISBN 978-0-521-56745-9.

Herbert H. Clark and Susan E. Brennan. Grounding in communication. 1991. URL https://psycnet.apa.org/record/1991-98452-006. Publisher: American Psychological Association.

Victoria Clarke and Virginia Braun. Thematic analysis. *The Journal of Positive Psychology*, 12(3):297–298, May 2017. ISSN 1743-9760. . URL https://doi.org/10.1080/17439760.2016.1262613. Publisher: Routledge _eprint: https://doi.org/10.1080/17439760.2016.1262613.

Abi Cook, Meg Thompson, and Paddy Ross. Virtual first impressions: Zoom backgrounds affect judgements of trust and competence. *Plos one*, 18(9):e0291444, 2023. URL https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0291444&. Publisher: Public Library of Science.

Gus Cooney, Adam M Mastroianni, Nicole Abi-Esber, and Alison Wood Brooks. The many minds problem: disclosure in dyadic versus group conversation. *Current*

Opinion in Psychology, 31:22–27, February 2020. ISSN 2352-250X. . URL https://www.sciencedirect.com/science/article/pii/S2352250X19300831.

W. Coppola, Nancy, Roxanne Hiltz, Starr, and G. Rotter, Naomi. Building trust in virtual teams. *IEEE Transactions on Professional Communication*, 47(2):95–104, June 2004. ISSN 1558-1500. . URL https://ieeexplore.ieee.org/abstract/document/1303807. Conference Name: IEEE Transactions on Professional Communication.

Kevin Corti and Alex Gillespie. Co-constructing intersubjectivity with artificial conversational agents: People are more likely to initiate repairs of misunderstandings with agents represented as human. *Computers in Human Behavior*, 58:431–442, May 2016. ISSN 0747-5632. . URL https://www.sciencedirect.com/science/article/pii/S0747563215303101.

Ana Cristina Costa, Robert A. Roe, and Tharsi Taillieu. Trust within teams: The relation with performance effectiveness. *European Journal of Work and Organizational Psychology*, 10(3):225–244, September 2001. ISSN 1359-432X. . URL https://doi.org/10.1080/13594320143000654. Publisher: Routledge _eprint: https://doi.org/10.1080/13594320143000654.

Costa Ana Cristina, Fulmer C. Ashley, and Anderson Neil R. Trust in work teams: An integrative review, multilevel model, and future directions. *Journal of Organizational Behavior*, 39(2):169–184, 2018. .

Emmelyn AJ Croes, Marjolijn L. Antheunis, Alexander P. Schouten, and Emiel J. Krahmer. Teasing apart the effect of visibility and physical co-presence to examine the effect of CMC on interpersonal attraction. *Computers in Human Behavior*, 55:468–476, 2016. URL https://www.sciencedirect.com/science/article/pii/S0747563215301680. Publisher: Elsevier.

Nathan Culmer, Todd Brenton Smith, Catanya Stager, Andrea Wright, Abigail Fickel, Jet Tan, Carlos (Trey) Clark, Hannah Meyer, and Katherine Grimm. Asynchronous Telemedicine: A Systematic Literature Review. *Telemedicine Reports*, 4(1):366–386, December 2023. ISSN 2692-4366. . URL https://www.liebertpub.com/doi/10.1089/tmr.2023.0052.

Laura Dabbish and Robert Kraut. **Research Note** —Awareness Displays and Social Motivation for Coordinating Communication. *Information Systems Research*, 19(2):221–238, June 2008. ISSN 1047-7047, 1526-5536. . URL https://pubsonline.informs.org/doi/10.1287/isre.1080.0175.

Richard L. Daft, Robert H. Lengel, and Linda Klebe Trevino. Message equivocality, media selection, and manager performance: Implications for information systems. *MIS quarterly*, pages 355–366, 1987. Publisher: JSTOR.

Stéphane D. Dandeneau, Mark W. Baldwin, Jodene R. Baccus, Maya Sakellaropoulo, and Jens C. Pruessner. Cutting stress off at the pass: Reducing vigilance and responsiveness to social threat by manipulating attention. *Journal of Personality and Social Psychology*, 93:651–666, 2007. ISSN 1939-1315. . Place: US Publisher: American Psychological Association.

Jianguanglung Dangmei. Building trust in a virtual team: A conceptual framework. *International Journal of Management and Social Science Research Review*, 1(29), 2016. URL https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2876029.

Fred D. Davis. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13(3):319–340, 1989. ISSN 0276-7783. . URL https://www.jstor.org/stable/249008. Publisher: Management Information Systems Research Center, University of Minnesota.

Edward De Bono. Serious creativity. *The Journal for Quality and Participation*, 18(5):12, 1995. URL https://search.proquest.com/openview/b867602babfb901628af868f33ea6603/1?pq-origsite=gscholar&cbl=37083. Publisher: American Society for Quality.

Bart A. De Jong and Tom Elfring. How Does Trust Affect the Performance of Ongoing Teams? The Mediating Role of Reflexivity, Monitoring, and Effort. *Academy of Management Journal*, 53(3):535–549, June 2010. ISSN 0001-4273. . URL https://journals.aom.org/doi/abs/10.5465/amj.2010.51468649. Publisher: Academy of Management.

Jay R. Dee, Susan Dole, Charles Phair, and Pat Shay. Trust and Collaboration in "Zero-History" Administrative Teams. Technical report, April 2002. URL https://eric.ed.gov/?id=ED478599. ERIC Number: ED478599.

Ziedune Degutyte and Arlene Astell. The role of eye gaze in regulating turn taking in conversations: a systematized review of methods and findings. *Frontiers in Psychology*, 12:616471, 2021. URL https://www.frontiersin.org/articles/10.3389/fpsyg.2021.616471/full. Publisher: Frontiers Media SA.

Alan R. Dennis, Robert M. Fuller, and Joseph S. Valacich. Media, Tasks, and Communication Processes: A Theory of Media Synchronicity. *MIS Quarterly*, 32(3):575–600, 2008. ISSN 0276-7783. . URL https://www.jstor.org/stable/25148857. Publisher: Management Information Systems Research Center, University of Minnesota.

Ansgar E. Depping, Regan L. Mandryk, Colby Johanson, Jason T. Bowey, and Shelby C. Thomson. Trust Me: Social Games are Better than Social Icebreakers at Building Trust. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play*, CHI PLAY '16, pages 116–129, New York, NY, USA, October 2016. Association for Computing Machinery. ISBN 978-1-4503-4456-2. . URL https://doi.org/10.1145/2967934.2968097.

Daantje Derks, Agneta H. Fischer, and Arjan ER Bos. The role of emotion in computer-mediated communication: A review. *Computers in human behavior*, 24 (3):766–785, 2008. URL https://www.sciencedirect.com/science/article/pii/S0747563207000866. Publisher: Elsevier.

V. J. Derlega, S. Metts, S. Petronio, and S. T. Margulis. Self–disclosure, Sage Publications, 1993.

Gerardine DeSanctis and Peter Monge. Introduction to the Special Issue: Communication Processes for Virtual Organizations. *Organization Science*, 10(6):693–703, December 1999. ISSN 1047-7039. . URL https://pubsonline.informs.org/doi/abs/10.1287/orsc.10.6.693. Publisher: INFORMS.

Joan Morris DiMicco, Anna Pandolfo, and Walter Bender. Influencing group participation with a shared display. In *Proceedings of the 2004 ACM conference on Computer supported cooperative work*, pages 614–623, Chicago Illinois USA, November 2004. ACM. ISBN 978-1-58113-810-8. . URL https://dl.acm.org/doi/10.1145/1031607.1031713.

Kurt T. Dirks. The effects of interpersonal trust on work group performance. *Journal of Applied Psychology*, 84:445–455, 1999. ISSN 1939-1854. . Place: US Publisher: American Psychological Association.

Alan Dix. Deconstructing Experience: Pulling Crackers Apart. In Mark Blythe and Andrew Monk, editors, *Funology 2: From Usability to Enjoyment*, Human–Computer Interaction Series, pages 451–467. Springer International Publishing, Cham, 2018. ISBN 978-3-319-68213-6. . URL https://doi.org/10.1007/978-3-319-68213-6_29.

Sidney D'mello and Art Graesser. AutoTutor and affective autotutor: Learning by talking with cognitively and emotionally intelligent computers that talk back. *ACM Trans. Interact. Intell. Syst.*, 2(4):23:1–23:39, January 2013. ISSN 2160-6455. . URL https://doi.org/10.1145/2395123.2395128.

Roger L. Dominowski. Productive problem solving. In *The creative cognition approach*, pages 73–95. The MIT Press, Cambridge, MA, US, 1995. ISBN 978-0-262-19354-2.

Michelle Drouin, Daniel Miller, Shaun M. J. Wehle, and Elisa Hernandez. Why do people lie online? "Because everyone lies on the internet". *Computers in Human Behavior*, 64:134–142, November 2016. ISSN 0747-5632. . URL https://www.sciencedirect.com/science/article/pii/S0747563216304800.

Group Dynamics. The Pirate Ship, 2024. URL https://en.dinamicasgrupales.com.ar/activities-and-games/team-building/the-pirate-ship/.

Amy Edmondson. Psychological Safety and Learning Behavior in Work Teams. *Administrative Science Quarterly*, 44(2):350–383, June 1999. ISSN 0001-8392. . URL

https://journals.sagepub.com/action/showAbstract. Publisher: SAGE Publications Inc.

Suzanne Eggins and Diana Slade. *Analysing Casual Conversation*. Equinox Publishing Ltd., 2004. ISBN 978-1-84553-046-4. Google-Books-ID: cTEkm6WzfNgC.

J. Alberto Espinosa, Sandra A. Slaughter, Robert E. Kraut, and James D. Herbsleb. Team knowledge and coordination in geographically distributed software development. *Journal of management information systems*, 24(1):135–169, 2007. Publisher: Taylor & Francis.

Sabine Fabriz, Julia Mendzheritskaya, and Sebastian Stehle. Impact of Synchronous and Asynchronous Settings of Online Teaching and Learning in Higher Education on Students' Learning Experience During COVID-19. *Frontiers in Psychology*, 12, October 2021. ISSN 1664-1078. . URL https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2021.733554/full. Publisher: Frontiers.

Heather A. Faucett, Matthew L. Lee, and Scott Carter. I Should Listen More: Real-time Sensing and Feedback of Non-Verbal Communication in Video Telehealth. *Proceedings of the ACM on Human-Computer Interaction*, 1(CSCW):1–19, December 2017. ISSN 2573-0142. . URL https://dl.acm.org/doi/10.1145/3134679.

Geraldine Fauville, Mufan Luo, Anna Carolina Muller Queiroz, Jeremy N. Bailenson, and Jeff Hancock. Zoom exhaustion & fatigue scale. *Computers in Human Behavior Reports*, 4:100119, 2021. URL https://www.sciencedirect.com/science/article/pii/S2451958821000671. Publisher: Elsevier.

Anne-Laure Fayard and Gerardine DeSanctis. Enacting language games: the development of a sense of 'we-ness' in online forums. *Information Systems Journal*, 20(4): 383–416, July 2010. ISSN 1350-1917, 1365-2575. . URL https://onlinelibrary.wiley.com/doi/10.1111/j.1365-2575.2009.00335.x.

Bj Fogg. A behavior model for persuasive design. In *Proceedings of the 4th International Conference on Persuasive Technology*, pages 1–7, Claremont California USA, April 2009. ACM. ISBN 978-1-60558-376-1. . URL https://dl.acm.org/doi/10.1145/1541948.1541999.

J. S. La Fontaine. *The Interpretation of Ritual*. Routledge, December 2012. ISBN 978-1-135-65007-0. Google-Books-ID: a4qRw8Wp1pEC.

Jennifer A Fredricks, Phyllis C Blumenfeld, and Alison H Paris. School Engagement: Potential of the Concept, State of the Evidence. *Review of Educational Research*, 74(1): 59–109, March 2004. ISSN 0034-6543, 1935-1046. . URL https://journals.sagepub.com/doi/10.3102/00346543074001059.

Barbara L. Fredrickson. The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist*, 56(3):218–226, 2001. ISSN 1935-990X. . Place: US Publisher: American Psychological Association.

Szu-Wei Fu, Yaran Fan, Yasaman Hosseinkashi, Jayant Gupchup, and Ross Cutler. Improving Meeting Inclusiveness using Speech Interruption Analysis. In *Proceedings of the 30th ACM International Conference on Multimedia*, pages 887–895, Lisboa Portugal, October 2022. ACM. ISBN 978-1-4503-9203-7. . URL https://dl.acm.org/doi/10.1145/3503161.3548379.

Stacie Furst, Richard Blackburn, and Benson Rosen. Virtual team effectiveness: A proposed research agenda. *Information systems journal*, 9(4):249–269, 1999. Publisher: Wiley Online Library.

Asbjørn Følstad and Marita Skjuve. Chatbots for customer service: user experience and motivation. In *Proceedings of the 1st International Conference on Conversational User Interfaces*, CUI '19, pages 1–9, New York, NY, USA, August 2019. Association for Computing Machinery. ISBN 978-1-4503-7187-2. . URL https://doi.org/10.1145/3342775.3342784.

Catherine Gabelica, Piet Van den Bossche, Mien Segers, and Wim Gijselaers. Feedback, a powerful lever in teams: A review. *Educational Research Review*, 7(2):123–144, June 2012. ISSN 1747-938X. . URL https://www.sciencedirect.com/science/article/pii/S1747938X11000492.

Angela Cora Garcia and Jennifer Baker Jacobs. The Eyes of the Beholder: Understanding the Turn-Taking System in Quasi-Synchronous Computer-Mediated Communication. *Research on Language and Social Interaction*, 32(4):337–367, October 1999. ISSN 0835-1813, 1532-7973. . URL http://www.tandfonline.com/doi/abs/10.1207/S15327973rls3204_2.

Jessica Gasiorek. *Message Processing: The Science of Creating Understanding*. University of Hawai'i OER, 2017. URL https://pressbooks-dev.oer.hawaii.edu/messageprocessing/.

Cristina B. Gibson and Susan G. Cohen. *Virtual teams that work: Creating conditions for virtual team effectiveness*. John Wiley & Sons, 2003. URL https://books.google.com/books?hl=en&lr=&id=Skly8bshKoEC&oi=fnd&pg=PR9&dq=Cohen,+S.+G.,+%26+Gibson,+C.+B.+(2003).+Virtual+Teams+That+Work:+Creating+Conditions+for+Virtual+Team+Effectiveness.+San+Francisco,+CA:+Jossey-Bass.&ots=yBRxfj_07U&sig=jxa-wa4BGV__X037rDFy93IIdB8.

Howard Giles, Justine Coupland, and Nikolas Coupland. *Contexts of Accommodation: Developments in Applied Sociolinguistics*. Cambridge University Press, September 1991. ISBN 978-0-521-36151-4. Google-Books-ID: vnKCc4QO7gQC.

Ulrich Gnewuch, Stefan Morana, Marc Adam, and Alexander Maedche. Faster is not always better: understanding the effect of dynamic response delays in human-chatbot interaction. 2018. URL https://scholar.archive.org/work/664dlhdlrbdvffn4jb4zir4toa/access/wayback/https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1112&context=ecis2018_rp.

Gerald J. Gorn, Amitava Chattopadhyay, Tracey Yi, and Darren W. Dahl. Effects of Color as an Executional Cue in Advertising: They're in the Shade. *Management Science*, 43(10):1387–1400, October 1997. ISSN 0025-1909, 1526-5501. . URL https://pubsonline.informs.org/doi/10.1287/mnsc.43.10.1387.

William B. Gudykunst and Tsukasa Nishida. *Bridging Japanese/North American differences*, volume 1. Sage, 1994. URL https://books.google.com/books?hl=en&lr=&id=H47dpXaMO_4C&oi=fnd&pg=PP9&dq=Gudykunst,+W.+B.,+%26+Nishida,+T.+(2001).+Bridging+Japanese/North+American+differences.+Intercultural+Communication+Studies.&ots=PY2LiAp684&sig=8ocvtpylSv4Fw8ZLcvIotwAtxYQ.

Jamie Guillory and Jeffrey T. Hancock. The Effect of Linkedin on Deception in Resumes. *Cyberpsychology, Behavior, and Social Networking*, 15(3):135–140, March 2012. ISSN 2152-2715. . URL https://www.liebertpub.com/doi/abs/10.1089/cyber.2011.0389. Publisher: Mary Ann Liebert, Inc., publishers.

Charlotte N. Gunawardena. Social presence theory and implications for interaction and collaborative learning in computer conferences. *International journal of educational telecommunications*, 1(2):147–166, 1995. URL https://www.learntechlib.org/p/15156/. Publisher: Association for the Advancement of Computing in Education (AACE).

Megan R. Gunnar and Bonny Donzella. Social regulation of the cortisol levels in early human development. *Psychoneuroendocrinology*, 27(1):199–220, January 2002. ISSN 0306-4530. . URL https://www.sciencedirect.com/science/article/pii/S0306453001000452.

Ge Guo, Gilly Leshed, and Keith Evan Green. "I normally wouldn't talk with strangers": Introducing a Socio-Spatial Interface for Fostering Togetherness Between Strangers. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, CHI '23, pages 1–20, New York, NY, USA, April 2023. Association for Computing Machinery. ISBN 978-1-4503-9421-5. . URL https://dl.acm.org/doi/10.1145/3544548.3581325.

Jenny Gutman, Ilanit Gordon, and Noa Vilchinsky. Is Social Presence Indeed Present in Remote Social Interactions? A Call for Incorporating Physiological Measures of Synchrony When Assessing the Social Nature of Interpersonal Interactions via Videoconferencing Platforms. *Frontiers in Psychology*, 13, March 2022. ISSN 1664-1078.

. URL https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2022.822535/full. Publisher: Frontiers.

Janine Hacker, vom Brocke , Jan, Handali , Joshua, Otto , Markus, , and Johannes Schneider. Virtually in this together – how web-conferencing systems enabled a new virtual togetherness during the COVID-19 crisis. *European Journal of Information Systems*, 29(5):563–584, September 2020. ISSN 0960-085X. . URL https://doi.org/10.1080/0960085X.2020.1814680. Publisher: Taylor & Francis _eprint: https://doi.org/10.1080/0960085X.2020.1814680.

J. Richard Hackman. Work redesign and motivation. *Professional Psychology*, 11(3): 445–455, 1980. ISSN 0033-0175. . Place: US Publisher: American Psychological Association.

J. Richard Hackman and Neil Vidmar. Effects of size and task type on group performance and member reactions. *Sociometry*, pages 37–54, 1970. Publisher: JSTOR.

Edward T. Hall. Beyond culture. *Garden City*, 1976.

Djamil Hasim. Practical Model of Organizational Personnel Competence Initiation Via Competency Based Interview. *Jurnal Ilmiah Ilmu Administrasi Publik: Jurnal Pemikiran dan Penelitian Administrasi Publik*, 9(2):287–294, 2019.

John Hattie and Helen Timperley. The Power of Feedback. *Review of Educational Research*, 77(1):81–112, March 2007. ISSN 0034-6543, 1935-1046. . URL https://journals.sagepub.com/doi/10.3102/003465430298487.

Helen Ai He, Naomi Yamashita, Chat Wacharamanotham, Andrea B. Horn, Jenny Schmid, and Elaine M. Huang. Two Sides to Every Story: Mitigating Intercultural Conflict through Automated Feedback and Shared Self-Reflections in Global Virtual Teams. *Proceedings of the ACM on Human-Computer Interaction*, 1(CSCW):1–21, December 2017. ISSN 2573-0142. . URL https://dl.acm.org/doi/10.1145/3134686.

Chip Heath and Dan Heath. *The Power of Moments: Why Certain Experiences Have Extraordinary Impact*. Random House, October 2017. ISBN 978-1-4735-4458-1. Google-Books-ID: AV3aDQAAQBAJ.

Michael L. Hecht. The Conceptualization And Measurement of Interpersonal Communication Satisfaction. *Human Communication Research*, 4(3):253–264, March 1978. ISSN 0360-3989, 1468-2958. . URL https://academic.oup.com/hcr/article/4/3/253-264/4626815.

Mattias Heldner and Jens Edlund. Pauses, gaps and overlaps in conversations. *Journal of Phonetics*, 38(4):555–568, 2010. URL https://www.sciencedirect.com/science/article/pii/S0095447010000628. Publisher: Elsevier.

Susan Herring. A faceted classification scheme for computer-mediated discourse. *Language@ internet*, 4, 2007. URL https://scholarworks.iu.edu/journals/index.php/li/article/view/37562.

Guido Hertel, Susanne Geister, and Udo Konradt. Managing virtual teams: A review of current empirical research. *Human resource management review*, 15 (1):69–95, 2005. URL https://www.sciencedirect.com/science/article/pii/S1053482205000033. Publisher: Elsevier.

Katherine Marie Hilton. What does an interruption sound like? 2018. URL https://purl.stanford.edu/vf660gm5432.

Pamela J. Hinds and Diane E. Bailey. Out of Sight, Out of Sync: Understanding Conflict in Distributed Teams. *Organization Science*, 14(6):615–632, December 2003. ISSN 1047-7039. . URL https://pubsonline.informs.org/doi/abs/10.1287/orsc.14.6.615.24872. Publisher: INFORMS.

Pamela J. Hinds and Mark Mortensen. Understanding Conflict in Geographically Distributed Teams: The Moderating Effects of Shared Identity, Shared Context, and Spontaneous Communication. *Organization Science*, 16(3):290–307, June 2005. ISSN 1047-7039. . URL https://pubsonline.informs.org/doi/abs/10.1287/orsc.1050.0122. Publisher: INFORMS.

Pamela J. Hinds, Kathleen M. Carley, David Krackhardt, and Doug Wholey. Choosing work group members: Balancing similarity, competence, and familiarity. *Organizational behavior and human decision processes*, 81(2):226–251, 2000. Publisher: Elsevier.

Victoria Hoevemeyer. *High-impact interview questions: 701 behavior-based questions to find the right person for every job*. Amacom, 2017.

Mark Hooson. UK Remote And Hybrid Working Statistics 2025, May 2025. URL https://www.forbes.com/uk/advisor/business/remote-work-statistics/. Section: Business.

Stefan Hrastinski. Asynchronous and synchronous e-learning. *Educause quarterly*, 31(4):51–55, 2008. URL http://elearning.fit.hcmup.edu.vn/~longld/References%20for%20TeachingMethod&EduTechnology%20-%20Tai%20lieu%20PPDH%20&%20Cong%20Nghe%20Day%20Hoc/(Book)%20-%20Sach%20tham%20khao%20-%20eLearning/e-Learning%20Concepts/Asynchronous%20&%20Synchronous%20e-Learning%20(Hrastinski-2008).pdf.

Ryo Iijima, Shigeo Yoshida, Atsushi Hashimoto, and Jiaxin Ma. FairTalk: Facilitating Balanced Participation in Video Conferencing by Implicit Visualization of Predicted Turn-Grabbing Intention, May 2025. URL http://arxiv.org/abs/2505.20138. arXiv:2505.20138 [cs].

Iin Indrayanti. Icebreaker: A Strategy To Active Involvement For Young Adolescent Learners. 2014.

H. N. Io and C. B. Lee. Chatbots and conversational agents: A bibliometric analysis. In *2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*, pages 215–219, December 2017. . URL https://ieeexplore.ieee.org/abstract/document/8289883. ISSN: 2157-362X.

Lang C. J., Dony J. A., and Roberts S. The Future of Teamwork: Facilitating Effective Team Performance in Virtual and Hybrid Work Environments in a Post-pandemic World. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 66 (1):1085–1089, September 2022. ISSN 1071-1813. . URL https://doi.org/10.1177/1071181322661455. Publisher: SAGE Publications Inc.

Sirkka L. Jarvenpaa and Dorothy E. Leidner. Communication and Trust in Global Virtual Teams. *Organization Science*, 10(6):791–815, December 1999. ISSN 1047-7039, 1526-5455. . URL https://pubsonline.informs.org/doi/10.1287/orsc.10.6.791.

Sirkka L. Jarvenpaa, Kathleen Knoll, and Dorothy E. Leidner. Is Anybody out There? Antecedents of Trust in Global Virtual Teams. *Journal of Management Information Systems*, 14(4):29–64, March 1998. ISSN 0742-1222. . URL https://doi.org/10.1080/07421222.1998.11518185. Publisher: Routledge _eprint: https://doi.org/10.1080/07421222.1998.11518185.

S.L. Jarvenpaa, T.R. Shaw, and D.S. Staples. Toward contextualized theories of trust: The role of trust in global virtual teams. *Information Systems Research*, 15(3):250–267, 2004. .

M. Jayanthi and K. V. R. Rajandran. A study on multicultural team and the culture diversity in multi-national companies. *International Journal of Scientific Research*, 3(4): 104–106, 2014.

Oliver P. John and Sanjay Srivastava. The Big Five Trait taxonomy: History, measurement, and theoretical perspectives. In *Handbook of personality: Theory and research, 2nd ed*, pages 102–138. Guilford Press, New York, NY, US, 1999. ISBN 978-1-57230-483-3.

David W. Johnson, Roger T. Johnson, and Karl A. Smith. Cooperative learning: Improving university instruction by basing practice on validated theory. *Journal on Excellence in University Teaching*, 25(4):1–26, 2014. Publisher: Citeseer.

John A. Johnson. The "self-disclosure" and "self-presentation" views of item response dynamics and personality scale validity. *Journal of Personality and Social Psychology*, 40:761–769, 1981. ISSN 1939-1315. . Place: US Publisher: American Psychological Association.

R. Jolak, A. Wortmann, M. Chaudron, and B. Rumpe. Does distance still matter? Revisiting collaborative distributed software design. *IEEE Software*, 35(6):40–47, 2018. .

Brennan Jones, Yaying Zhang, Priscilla N. Y. Wong, and Sean Rintel. VROOM: Virtual Robot Overlay for Online Meetings. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, CHI EA '20, pages 1–10, Honolulu, HI, USA, April 2020. Association for Computing Machinery. ISBN 978-1-4503-6819-3. . URL https://doi.org/10.1145/3334480.3382820.

Eunice Jun, Daniel McDuff, and Mary Czerwinski. Circadian Rhythms and Physiological Synchrony: Evidence of the Impact of Diversity on Small Group Creativity. *Proceedings of the ACM on Human-Computer Interaction*, 3(CSCW):1–22, November 2019. ISSN 2573-0142, 2573-0142. . URL https://dl.acm.org/doi/10.1145/3359162.

Matthew K. Miller, Martin Johannes Dechant, and Regan L. Mandryk. Meeting You, Seeing Me: The Role of Social Anxiety, Visual Feedback, and Interface Layout in a Get-to-Know-You Task via Video Chat. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, CHI '21, pages 1–14, New York, NY, USA, May 2021. Association for Computing Machinery. ISBN 978-1-4503-8096-6. . URL https://doi.org/10.1145/3411764.3445664.

Yuecui Kan, Xuewei Wang, Xitong Chen, Hanxuan Zhao, Jijun Lan, and Haijun Duan. Acute stress reduces the emotional attentional blink: Evidence from human electrophysiology. *Cognitive, Affective, & Behavioral Neuroscience*, 21(1):58–73, February 2021. ISSN 1531-135X. . URL https://doi.org/10.3758/s13415-020-00847-9.

Katherine A. Karl, Joy V. Peluchette, and Navid Aghakhani. Virtual Work Meetings During the COVID-19 Pandemic: The Good, Bad, and Ugly. *Small Group Research*, 53(3):343–365, June 2022. ISSN 1046-4964. . URL https://doi.org/10.1177/10464964211015286. Publisher: SAGE Publications Inc.

Tatsuya Kawahara, Masayoshi Toyokura, Teruhisa Misu, and Chiori Hori. Detection of feeling through back-channels in spoken dialogue. In *INTERSPEECH*, page 1696. Citeseer, 2008. URL https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=c50cd954c46698229641d8d0d3ec8fd2a53f7a97.

Judy Kay, Peter Reimann, Elliot Diebold, and Bob Kummerfeld. MOOCs: So Many Learners, So Much Potential ... *IEEE Intelligent Systems*, 28(3):70–77, May 2013. ISSN 1941-1294. . URL https://ieeexplore.ieee.org/abstract/document/6588857.

Adam Kendon. *Conducting interaction: Patterns of behavior in focused encounters*, volume 7. CUP Archive, 1990. URL https://shorturl.at/rQVa3.

T. Khvatova and M. Block. Exploring the role of task-related trust in intra-organisational knowledge sharing. *International Journal of Human Resource Management*, 28(2):333–355, 2017. .

Sara Kiesler, Jane Siegel, and Timothy W. McGuire. Social psychological aspects of computer-mediated communication. *American psychologist*, 39(10):1123, 1984. URL https://psycnet.apa.org/journals/amp/39/10/1123/. Publisher: American Psychological Association.

Sara Kiesler, Bozena Zdaniuk, Vicki Lundmark, and Robert Kraut. Troubles With the Internet: The Dynamics of Help at Home. *Human–Computer Interaction*, 15(4):323–351, December 2000. ISSN 0737-0024, 1532-7051. . URL https://www.tandfonline.com/doi/full/10.1207/S15327051HCI1504_2.

Sandra Kiffin-Petersen. Trust: A Neglected Variable in Team Effectiveness Research. *Journal of Management & Organization*, 10(1):38–53, January 2004. ISSN 1324-3209. . URL https://www.cambridge.org/core/journals/journal-of-management-and-organization/article/abs/trust-a-neglected-variable-in-team-effectiveness-research/7698F3E966689435AABEC0330F66C4FF. Publisher: Cambridge University Press.

Miyea Kim, Mina Jun, and Jeongsoo Han. The relationship between needs, motivations and information sharing behaviors on social media: focus on the self-connection and social connection. *Asia Pacific Journal of Marketing and Logistics*, 35(1):1–16, January 2022. ISSN 1355-5855. . URL https://doi.org/10.1108/APJML-01-2021-0066. Publisher: Emerald Publishing Limited.

Taemie Kim, Agnes Chang, Lindsey Holland, and Alex Sandy Pentland. Meeting mediator: enhancing group collaborationusing sociometric feedback. In *Proceedings of the 2008 ACM conference on Computer supported cooperative work*, pages 457–466, San Diego CA USA, November 2008. ACM. ISBN 978-1-60558-007-4. . URL https://dl.acm.org/doi/10.1145/1460563.1460636.

Yanghee Kim and Amy L. Baylor. A Social-Cognitive Framework for Pedagogical Agents as Learning Companions. *Educational Technology Research and Development*, 54(6):569–596, December 2006. ISSN 1042-1629, 1556-6501. . URL http://link.springer.com/10.1007/s11423-006-0637-3.

Yanghee Kim, Amy L. Baylor, and PALS Group. Pedagogical Agents as Learning Companions: The Role of Agent Competency and Type of Interaction. *Educational Technology Research and Development*, 54(3):223–243, June 2006. ISSN 1042-1629, 1556-6501. . URL http://link.springer.com/10.1007/s11423-006-8805-z.

Chris L. Kleinke. Gaze and eye contact: a research review. *Psychological bulletin*, 100(1): 78, 1986. URL https://psycnet.apa.org/fulltext/1986-27160-001.html. Publisher: American Psychological Association.

Florian E. Klonek, Lehmann-Willenbrock , Nale, , and Simone Kauffeld. Dynamics of Resistance to Change: A Sequential Analysis of Change Agents in Action.

Journal of Change Management, 14(3):334–360, July 2014. ISSN 1469-7017. . URL https://doi.org/10.1080/14697017.2014.896392. Publisher: Routledge _eprint: https://doi.org/10.1080/14697017.2014.896392.

Bran Knowles, Mark Rouncefield, Mike Harding, Nigel Davies, Lynne Blair, James Hannon, John Walden, and Ding Wang. Models and Patterns of Trust. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*, CSCW '15, pages 328–338, New York, NY, USA, February 2015. Association for Computing Machinery. ISBN 978-1-4503-2922-4. . URL https://doi.org/10.1145/2675133.2675154.

Ned Kock. The Psychobiological Model: Towards a New Theory of Computer-Mediated Communication Based on Darwinian Evolution. *Organization Science*, 15 (3):327–348, June 2004. ISSN 1047-7039, 1526-5455. . URL https://pubsonline.informs.org/doi/10.1287/orsc.1040.0071.

Namkje Koudenburg, Tom Postmes, and Ernestine H. Gordijn. Resounding Silences: Subtle Norm Regulation in Everyday Interactions. *Social Psychology Quarterly*, 76(3): 224–241, September 2013. ISSN 0190-2725, 1939-8999. . URL https://journals.sagepub.com/doi/10.1177/0190272513496794.

Namkje Koudenburg, Tom Postmes, and Ernestine H. Gordijn. Beyond Content of Conversation: The Role of Conversational Form in the Emergence and Regulation of Social Structure. *Personality and Social Psychology Review*, 21(1):50–71, February 2017. ISSN 1088-8683, 1532-7957. . URL https://journals.sagepub.com/doi/10.1177/1088868315626022.

Steve WJ Kozlowski and Bradford S. Bell. Work groups and teams in organizations. *Handbook of psychology: Industrial and organizational psychology*, 12:333–375, 2003. URL https://books.google.com/books?hl=en&lr=&id=LK2x-bNjycoC&oi=fnd&pg=PA333&dq=Kozlowski,+S.+W.+J.,+%26+Bell,+B.+S.+(2013).+Work+groups+and+teams+in+organizations.&ots=4Tw1uyqRRU&sig=PCyJqTli23WaXAo5U6QbhkLRLoc. Publisher: Wiley.

Steve W.J. Kozlowski and Daniel R. Ilgen. Enhancing the Effectiveness of Work Groups and Teams. *Psychological Science in the Public Interest*, 7(3):77–124, December 2006. ISSN 1529-1006. . URL https://doi.org/10.1111/j.1529-1006.2006.00030.x. Publisher: SAGE Publications Inc.

Robert Kraut, Carmen Egido, and Jolene Galegher. Patterns of contact and communication in scientific research collaboration. In *Proceedings of the 1988 ACM conference on Computer-supported cooperative work - CSCW '88*, pages 1–12, Portland, Oregon, United States, 1988. ACM Press. ISBN 978-0-89791-282-2. . URL http://dl.acm.org/citation.cfm?doid=62266.62267.

Junyeong Kum, Sunghun Jung, and Myungho Lee. The effect of eye contact in multi-party conversations with virtual humans and mitigating the Mona Lisa effect. *Electronics*, 13(2):430, 2024. URL https://www.mdpi.com/2079-9292/13/2/430. Publisher: MDPI.

Lionel Laroche. *Managing cultural diversity in technical professions*. Routledge, 2012. URL https://books.google.com/books?hl=en&lr=&id=JaGEPZu4hHsC&oi=fnd&pg=PR1&dq=Laroche,+Lionel.+Managing+cultural+diversity+in+technical+professions.+Routledge,+2012.&ots=WUZvtR3TFA&sig=tdviVIPAwfZC2OBSTO7j_g_AHSc.

Bibb Latané and Martin J. Bourgeois. Dynamic Social Impact and the Consolidation, Clustering, Correlation, and Continuing Diversity of Culture. In *Blackwell Handbook of Social Psychology: Group Processes*, pages 235–258. John Wiley & Sons, Ltd, 2001. ISBN 978-0-470-99845-8. . URL https://onlinelibrary.wiley.com/doi/abs/10.1002/9780470998458.ch10. Section: 10 _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/9780470998458.ch10.

Jean-Philippe Laurenceau, Lisa Feldman Barrett, and Paula R. Pietromonaco. Intimacy as an interpersonal process: The importance of self-disclosure, partner disclosure, and perceived partner responsiveness in interpersonal exchanges. *Journal of Personality and Social Psychology*, 74(5):1238–1251, 1998. ISSN 1939-1315. . Place: US Publisher: American Psychological Association.

S Levine, D M Lyons, and A F Schatzberg. Psychobiological consequences of social relationships. *Annals of the New York Academy of Sciences*, 807:210–218, January 1997. ISSN 1749-6632. . URL https://doi.org/10.1111/j.1749-6632.1997.tb51922.x.

Stephen C. Levinson. Turn-taking in Human Communication–Origins and Implications for Language Processing. *Trends in Cognitive Sciences*, 20(1):6–14, January 2016. ISSN 1879-307X. .

Kai-Hui Liang, Weiyan Shi, Yoojung Oh, Hao-Chuan Wang, Jingwen Zhang, and Zhou Yu. Dialoging Resonance: How Users Perceive, Reciprocate and React to Chatbot's Self-Disclosure in Conversational Recommendations, November 2022. URL http://arxiv.org/abs/2106.01666. arXiv:2106.01666 [cs].

Lizi Liao, Grace Hui Yang, and Chirag Shah. Proactive Conversational Agents in the Post-ChatGPT World. In *Proceedings of the 46th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pages 3452–3455, Taipei Taiwan, July 2023. ACM. ISBN 978-1-4503-9408-6. . URL https://dl.acm.org/doi/10.1145/3539618.3594250.

Robert C. Liden, Smriti Anand, and Prajya Vidyarthi. Dyadic Relationships. *Annual Review of Organizational Psychology and Organizational Behavior*, 3(1):139–166, 2016.

. URL https://doi.org/10.1146/annurev-orgpsych-041015-062452. _eprint: https://doi.org/10.1146/annurev-orgpsych-041015-062452.

Anthony C. Little and S. Craig Roberts. Evolution, Appearance, and Occupational Success. *Evolutionary Psychology*, 10(5):782–801, December 2012. ISSN 1474-7049, 1474-7049. . URL http://journals.sagepub.com/doi/10.1177/147470491201000503.

Y. Liu, H. Chen, C. Liu, Chad Lin, and H. Chan. A model to evaluate the effectiveness of collaborative online learning teams–self-disclosure and social exchange theory perspective. *International Journal of Cyber Society and Education*, 3(2):117–132, 2010. Publisher: Citeseer.

James Lockwood and Susan Bergin. A neurofeedback system to promote learner engagement, July 2016. URL http://arxiv.org/abs/1607.06232. arXiv:1607.06232 [cs].

Di Lu and Rosta Farzan. Time to Introduce Myself! Impact of Self-disclosure Timing of Newcomers in Online Discussion Forums. In *Proceedings of the ACM Web Science Conference*, WebSci '15, pages 1–9, New York, NY, USA, June 2015. Association for Computing Machinery. ISBN 978-1-4503-3672-7. . URL https://doi.org/10.1145/2786451.2786478.

Florence Martin, Drew Polly, and Albert Ritzhaupt. Bichronous online learning: Blending asynchronous and synchronous online learning. *Educause Review*, 8, 2020.

Benjamin Masters and Ewen N. MacDonald. Variable delay affects conversational turn-taking behavior in the presence of background noise. *The Journal of the Acoustical Society of America*, 158(4):3107–3119, October 2025. ISSN 0001-4966. . URL https://pubs.aip.org/asa/jasa/article/158/4/3107/3368619/Variable-delay-affects-conversational-turn-taking.

Roger C. Mayer, James H. Davis, and F. David Schoorman. An Integrative Model Of Organizational Trust. *Academy of Management Review*, 20(3):709–734, July 1995. ISSN 0363-7425. . URL https://journals.aom.org/doi/abs/10.5465/AMR.1995.9508080335. Publisher: Academy of Management.

M. Travis Maynard, John E. Mathieu, Lucy L. Gilson, Diana R. Sanchez, and Matthew D. Dean. Do I Really Know You and Does It Matter? Unpacking the Relationship Between Familiarity and Information Elaboration in Global Virtual Teams. *Group & Organization Management*, 44(1):3–37, February 2019. ISSN 1059-6011. . URL https://doi.org/10.1177/1059601118785842. Publisher: SAGE Publications Inc.

Jamie McGrath and Nonso Nnamoko. TrackEd: An emotion tracking tool for e-meeting platforms. *Software Impacts*, 17:100560, 2023. URL https://www.sciencedirect.com/science/article/pii/S2665963823000970. Publisher: Elsevier.

David McNeill. Hand and mind: What gestures reveal about thought, 1992.

Darren Menabney. How To Use Storytelling To Build Stronger Remote Teams In The New Normal. URL https://shorturl.at/tFRN4. Section: Careers.

Mark E. Mendenhall, Joyce Osland, Allan Bird, Gary R. Oddou, Michael J. Stevens, Martha Maznevski, and Günter K. Stahl, editors. *Global Leadership: Research, Practice, and Development*. Routledge, New York, 3 edition, October 2017. ISBN 978-1-315-23290-4. .

Sebastian Molinillo, Rocío Aguilar-Illescas, Rafael Anaya-Sánchez, and María Vallespín-Arán. Exploring the impacts of interactions, social presence and emotional engagement on active collaborative learning in a social web-based environment. *Computers & Education*, 123:41–52, August 2018. ISSN 0360-1315. . URL https://www.sciencedirect.com/science/article/pii/S0360131518301003.

Luis D. Mora-Jimenez, Kryscia Ramírez-Benavides, Luis Quesada, Gustavo Lopez, and Luis A. Guerrero. User Experience in Communication and Collaboration Platforms: A Comparative Study Including Discord, Microsoft Teams, and Zoom. In Álvaro Rocha, Carlos Ferrás, Abel Méndez Porras, and Efren Jimenez Delgado, editors, *Information Technology and Systems*, volume 414, pages 52–61. Springer International Publishing, Cham, 2022. ISBN 978-3-030-96292-0 978-3-030-96293-7. . URL https://link.springer.com/10.1007/978-3-030-96293-7_6. Series Title: Lecture Notes in Networks and Systems.

Richard L. Moreland. The formation of small groups. In *Group processes*, Review of personality and social psychology, Vol. 8., pages 80–110. Sage Publications, Inc, Thousand Oaks, CA, US, 1987. ISBN 978-0-8039-3071-1 978-0-8039-3072-8.

Richard L. Moreland and John M. Levine. Socialization in Organizations and Work Groups. In *Groups at Work*. Psychology Press, 2001. ISBN 978-1-315-80598-6. Num Pages: 44.

Sarah Morrison-Smith and Jaime Ruiz. Challenges and barriers in virtual teams: a literature review. *SN Applied Sciences*, 2(6):1096, June 2020. ISSN 2523-3963, 2523-3971. . URL https://link.springer.com/10.1007/s42452-020-2801-5.

M. Muhlfelder, U. Klein, S. Simon, and H. Luczak. Teams without trust? Investigations in the influence of video-mediated communication on the origin of trust among cooperating persons. *Behaviour & Information Technology*, 18(5):349–360, January 1999. ISSN 0144-929X. . URL https://doi.org/10.1080/014492999118931. Publisher: Taylor & Francis _eprint: https://doi.org/10.1080/014492999118931.

Kumiko Murata. Intrusive or co-operative? A cross-cultural study of interruption. *Journal of Pragmatics*, 21(4):385–400, April 1994. ISSN 0378-2166. . URL https://www.sciencedirect.com/science/article/pii/0378216694900116.

George Catalin Muresan, Sebastian Mititelu, and Josh Andres. "Should I Introduce myself?": Asynchronous semi-guided professional introductions for enhanced perceived team effectiveness in new virtual dyadic teams. *International Journal of Human-Computer Studies*, 188:103279, 2024. URL https://www.sciencedirect.com/science/article/pii/S1071581924000636. Publisher: Elsevier.

Robby Nadler. Understanding "Zoom fatigue": Theorizing spatial dynamics as third skins in computer-mediated communication. *Computers and Composition*, 58:102613, 2020. URL https://www.sciencedirect.com/science/article/pii/S8755461520300748. Publisher: Elsevier.

Lukas Nagel, Oliver Karras, Seyed Mahdi Amiri, and Kurt Schneider. Turning asynchronicity into an opportunity: asynchronous communication for shared understanding with vision videos. *Requirements Engineering*, 29(1):49–71, March 2024. ISSN 0947-3602, 1432-010X. . URL https://link.springer.com/10.1007/s00766-024-00414-5.

Michael A. Neblo, Kevin M. Esterling, and David MJ Lazer. *Politics with the people: Building a directly representative democracy*, volume 555. Cambridge University Press, 2018. URL https://books.google.com/books?hl=en&lr=&id=rnlnDwAAQBAJ&oi=fnd&pg=PR1&dq=Neblo,+M.+A.,+Esterling,+K.+M.,+Kennedy,+R.+P.,+Lazer,+D.,+%26+Sokhey,+A.+E.+(2018).+Politics+with+the+People:+Building+a+Directly+Representative+Democracy.+Cambridge+University+Press.&ots=Ruf7eTpA65&sig=EqO_RgxzcC6qCSqwb_QT7jh-ik8.

Vivian M. Nguyen, Christina Bell, Valerie Berseth, Christopher Cvitanovic, Ray Darwent, Matthew Falconer, Jenna Hutchen, Tyreen Kapoor, Nicole Klenk, and Nathan Young. Promises and pitfalls of digital knowledge exchange resulting from the COVID-19 pandemic. *Socio-Ecological Practice Research*, 3(4):427–439, December 2021. ISSN 2524-5287. . URL https://doi.org/10.1007/s42532-021-00097-0.

Paula M. Niedenthal, Lawrence W. Barsalou, Piotr Winkielman, Silvia Krauth-Gruber, and François Ric. Embodiment in Attitudes, Social Perception, and Emotion. *Personality and Social Psychology Review*, 9(3):184–211, August 2005. ISSN 1088-8683, 1532-7957. . URL https://journals.sagepub.com/doi/10.1207/s15327957pspr0903_1.

Zakaria Norhayati and Mohd Yusof Shafiz Affendi. Crossing Cultural Boundaries Using the Internet: Toward Building a Model of Swift Trust Formation in Global Virtual Teams. *Journal of International Management*, 26(1), 2020. .

Don Norman. The Design of Everyday Things: Revised and Expanded Edition, 2013. URL https://www.nngroup.com/books/design-everyday-things-revised/.

Rebecca Nowland, Elizabeth A. Necka, and John T. Cacioppo. Loneliness and Social Internet Use: Pathways to Reconnection in a Digital World? *Perspectives on Psychological Science*, 13(1):70–87, January 2018. ISSN 1745-6916, 1745-6924. . URL https://journals.sagepub.com/doi/10.1177/1745691617713052.

Niina Nurmi and Pamela J. Hinds. Work Design for Global Professionals: Connectivity demands, connectivity behaviors, and their effects on psychological and behavioral outcomes. *Organization Studies*, 41(12):1697–1724, December 2020. ISSN 0170-8406. . URL https://doi.org/10.1177/0170840620937885. Publisher: SAGE Publications Ltd.

Catherine S. Oh, Jeremy Bailenson, and Gregory F. Welch. A systematic review of social presence: Definition, antecedents, and implications. *Frontiers in Robotics and AI*, 5: 114, 2018. URL https://www.frontiersin.org/articles/10.3389/frobt.2018.00114/full. Publisher: Frontiers Media SA.

Judith S. Olson and Gary M. Olson. Working together apart: Collaboration over the internet. *Synthesis Lectures on Human-Centered Informatics*, 6(5):1–151, 2013. Publisher: Morgan & Claypool Publishers.

Thomas Olsson, Pradthana Jarusriboonchai, Paweł Woźniak, Susanna Paasovaara, Kaisa Väänänen, and Andrés Lucero. Technologies for Enhancing Collocated Social Interaction: Review of Design Solutions and Approaches. *Computer Supported Cooperative Work (CSCW)*, 29(1):29–83, April 2020. ISSN 1573-7551. . URL https://doi.org/10.1007/s10606-019-09345-0.

A. D. Owens and R. L. Hite. Enhancing student communication competencies in STEM using virtual global collaboration project based learning. *Research in Science & Technological Education*, 40(1):76–102, January 2022. ISSN 0263-5143. . URL https://doi.org/10.1080/02635143.2020.1778663. Publisher: Routledge _eprint: https://doi.org/10.1080/02635143.2020.1778663.

Faizuniah Pangil and Joon Moi Chan. The mediating effect of knowledge sharing on the relationship between trust and virtual team effectiveness. *Journal of Knowledge Management*, 18(1):92–106, January 2014. ISSN 1367-3270. . URL https://doi.org/10.1108/JKM-09-2013-0341. Publisher: Emerald Group Publishing Limited.

Ravi Paul, John R. Drake, and Huigang Liang. Global Virtual Team Performance: The Effect of Coordination Effectiveness, Trust, and Team Cohesion. *IEEE Transactions on Professional Communication*, 59(3):186–202, September 2016. ISSN 1558-1500. . URL https://ieeexplore.ieee.org/abstract/document/7552617. Conference Name: IEEE Transactions on Professional Communication.

Ravi C. Paul, Christopher P. Furner, John R. Drake, Richard D. Hauser, and Eric Kisling. The Moderating Effect of Virtuality on Team Trust and Effectiveness. *IEEE Transactions on Professional Communication*, 64(2):185–200, June 2021. ISSN 0361-1434, 1558-1500. . URL https://ieeexplore.ieee.org/document/9424992/.

Andy Pearson. Desert Island Game, 2024. URL https://www.sessionlab.com/methods/the-desert-island.

Alex Pentland. Social Dynamics: Signals and Behavior. *International Conference on Developmental Learning*, 5:1–5, 2004.

Anthony G. Picciano. Beyond student perceptions: Issues of interaction, presence, and performance in an online course. *Journal of Asynchronous learning networks*, 6(1):21–40, 2002. URL https://pdfs.semanticscholar.org/bfdd/f2c4078b58aefd05b8ba7000aca1338f16d8.pdf.

Danielle Pillet-Shore. Doing Introductions: The Work Involved in Meeting Someone New. *Communication Monographs*, 78(1):73–95, March 2011. ISSN 0363-7751. . URL https://doi.org/10.1080/03637751.2010.542767. Publisher: Routledge _eprint: https://doi.org/10.1080/03637751.2010.542767.

Clay Posey, Paul Benjamin Lowry, Tom L Roberts, and T Selwyn Ellis. Proposing the online community self-disclosure model: the case of working professionals in France and the U.K. who use online communities. *European Journal of Information Systems*, 19 (2):181–195, April 2010. ISSN 0960-085X. . URL https://doi.org/10.1057/ejis.2010.15. Publisher: Taylor & Francis _eprint: https://doi.org/10.1057/ejis.2010.15.

Yufan Sunny Qin and Linjuan Rita Men. Exploring the impact of internal communication on employee psychological well-being during the COVID-19 pandemic: The mediating role of employee organizational trust. *International Journal of Business Communication*, page 23294884221081838, 2022. Publisher: SAGE Publications Sage CA: Los Angeles, CA.

Sumita Raghuram, N. Sharon Hill, Jennifer L. Gibbs, and Likoebe M. Maruping. Virtual Work: Bridging Research Clusters. *Academy of Management Annals*, 13(1):308–341, January 2019. ISSN 1941-6520. . URL https://journals.aom.org/doi/abs/10.5465/annals.2017.0020. Publisher: Academy of Management.

Byron Reeves and Clifford Ivar Nass. *The media equation: How people treat computers, television, and new media like real people and places*. The media equation: How people treat computers, television, and new media like real people and places. Cambridge University Press, New York, NY, US, 1996. ISBN 978-1-57586-052-7. Pages: xiv, 305.

Byron Reeves and J. Leighton Read. *Total Engagement: How Games and Virtual Worlds Are Changing the Way People Work and Businesses Compete*. Harvard Business Press, November 2009. ISBN 978-1-4221-5513-4. Google-Books-ID: hbFSia7bdUoC.

Symonds Research. Space Station Research Team Building Activity Exercises, 2024. URL https://symondsresearch.com/stranded-space-station-teambuilding-activity/. Section: Team Building Activities.

Ronald E. Rice. Media Appropriateness.: Using Social Presence Theory to Compare Traditional and New Organizational Media. *Human Communication Research*, 19(4): 451–484, June 1993. ISSN 0360-3989, 1468-2958. . URL https://academic.oup.com/hcr/article/19/4/451-484/4575862.

Giuseppe Riva, Brenda K. Wiederhold, and Fabrizia Mantovani. Searching for the Metaverse: Neuroscience of Physical and Digital Communities. *Cyberpsychology, Behavior, and Social Networking*, 27(1):9–18, January 2024. ISSN 2152-2715. . URL https://www.liebertpub.com/doi/full/10.1089/cyber.2023.0040. Publisher: Mary Ann Liebert, Inc., publishers.

Elena Rocco, Thomas Finholt, Erik C. Hofer, and James Herbsleb. Designing as if trust mattered. *Collaboratory for Research on Electronic Work (CREW) Technical Report*, 2000. Publisher: Citeseer.

Shane L. Rogers, Rebecca Broadbent, Jemma Brown, Alan Fraser, and Craig P. Speelman. Realistic motion avatars are the future for social interaction in virtual reality. *Frontiers in Virtual Reality*, 2:750729, 2022. URL https://www.frontiersin.org/articles/10.3389/frvir.2021.750729/full. Publisher: Frontiers Media SA.

Pamela Rogerson-Revell. Using English for International Business: A European case study. *English for Specific Purposes*, 26(1):103–120, January 2007. ISSN 0889-4906. . URL https://www.sciencedirect.com/science/article/pii/S0889490606000020.

Ellen Rusman, Jan van Bruggen, Peter Sloep, Martin Valcke, and Rob Koper. The Mind's Eye on Personal Profiles: A Cognitive Perspective on Profile Elements that Inform Initial Trustworthiness Assessments and Social Awareness in Virtual Project Teams. *Computer Supported Cooperative Work (CSCW)*, 22(2):159–179, April 2013a. ISSN 1573-7551. . URL https://doi.org/10.1007/s10606-012-9171-5.

Ellen Rusman, Jan Van Bruggen, Peter Sloep, Martin Valcke, and Rob Koper. The mind's eye on personal profiles: A cognitive perspective on profile elements that inform initial trustworthiness assessments and social awareness in virtual project teams. *Computer Supported Cooperative Work (CSCW)*, 22:159–179, 2013b. Publisher: Springer.

Philip S. DeOrtentiis, James K. Summers, Anthony P. Ammeter, Ceasar Douglas, and Gerald R. Ferris. Cohesion and satisfaction as mediators of the team trust – team effectiveness relationship: An interdependence theory perspective. *Career*

Development International, 18(5):521–543, January 2013. ISSN 1362-0436. . URL https://doi.org/10.1108/CDI-03-2013-0035. Publisher: Emerald Group Publishing Limited.

Harvey Sacks. Lectures on conversation: Volume I. *Malden, Massachusetts: Blackwell*, 1992. Publisher: Wiley Online Library.

Harvey Sacks, Emanuel A. Schegloff, and Gail Jefferson. A simplest systematics for the organization of turn-taking for conversation. *language*, 50(4):696–735, 1974. URL https://muse.jhu.edu/pub/24/article/452679/summary. Publisher: Linguistic Society of America.

Samiha Samrose, Reza Rawassizadeh, and Ehsan Hoque. Immediate or Reflective?: Effects of Real-timeFeedback on Group Discussions over Videochat, November 2020. URL http://arxiv.org/abs/2011.06529. arXiv:2011.06529 [cs].

May-Britt Aronsen Sand. Can you trust someone you have never met? Swift trust and self-disclosure in temporary teams. Master's thesis, UiT Norges arktiske universitet, August 2020. URL https://munin.uit.no/handle/10037/19865. Accepted: 2020-11-18T06:48:11Z.

Suprateek Sarker, Saonee Sarker, Arvin Sahaym, and Niels Bjørn-Andersen. Exploring Value Cocreation in Relationships Between an ERP Vendor and its Partners: A Revelatory Case Study. *MIS Quarterly*, 36(1):317–338, 2012. ISSN 0276-7783. . URL https://www.jstor.org/stable/41410419. Publisher: Management Information Systems Research Center, University of Minnesota.

Ann E Schlosser. Self-disclosure versus self-presentation on social media. *Current Opinion in Psychology*, 31:1–6, February 2020. ISSN 2352-250X. . URL https://www.sciencedirect.com/science/article/pii/S2352250X19300685.

m.c. schraefel. in5: a Model for Inbodied Interaction. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*, CHI EA '19, pages 1–6, New York, NY, USA, May 2019. Association for Computing Machinery. ISBN 978-1-4503-5971-9. . URL https://doi.org/10.1145/3290607.3312977.

m.c. schraefel, George Catalin Muresan, and Eric Hekler. Experiment in a Box (XB): An Interactive Technology Framework for Sustainable Health Practices. *Frontiers in Computer Science*, 0, 2021. ISSN 2624-9898. . URL https://www.frontiersin.org/articles/10.3389/fcomp.2021.661890/full. Publisher: Frontiers.

Jonathon P. Schuldt, Christopher F. Chabris, Anita Williams Woolley, and J. Richard Hackman. Confidence in dyadic decision making: The role of individual differences. *Journal of Behavioral Decision Making*, 30(2):168–180, 2017. Publisher: Wiley Online Library.

Sandy Schumann, Olivier Klein, Karen Douglas, and Miles Hewstone. When is computer-mediated intergroup contact most promising? Examining the effect of out-group members' anonymity on prejudice. *Computers in Human Behavior*, 77:198–210, 2017. URL https://www.sciencedirect.com/science/article/pii/S0747563217304739. Publisher: Elsevier.

Linoy Schwartz, Jonathan Levy, Yaara Endevelt-Shapira, Amir Djalovski, Olga Hayut, Guillaume Dumas, and Ruth Feldman. Technologically-assisted communication attenuates inter-brain synchrony. *Neuroimage*, 264:119677, 2022. URL https://www.sciencedirect.com/science/article/pii/S1053811922007984. Publisher: Elsevier.

Charles P. R. Scott and Jessica L. Wildman. Culture, Communication, and Conflict: A Review of the Global Virtual Team Literature. In Jessica L. Wildman and Richard L. Griffith, editors, *Leading Global Teams: Translating Multidisciplinary Science to Practice*, pages 13–32. Springer, New York, NY, 2015. ISBN 978-1-4939-2050-1. . URL https://doi.org/10.1007/978-1-4939-2050-1_2.

John R. Searle. Proper Names. *Mind*, 67(266):166–173, 1958. ISSN 0026-4423. URL https://www.jstor.org/stable/2251108. Publisher: [Oxford University Press, Mind Association].

Abigail Sellen. Remote Conversations: The Effects of Mediating Talk With Technology. *Human-Computer Interaction*, 10(4):401–444, December 1995. ISSN 0737-0024. . URL http://www.tandfonline.com/doi/abs/10.1207/s15327051hci1004_2.

Vidya Setlur, Michael Correll, Arvind Satyanarayan, and Melanie Tory. Heuristics for Supporting Cooperative Dashboard Design. *IEEE Transactions on Visualization and Computer Graphics*, 30(1):370–380, January 2024. ISSN 1941-0506. . URL https://ieeexplore.ieee.org/abstract/document/10297573.

Lucas M. Seuren, Joseph Wherton, Trisha Greenhalgh, and Sara E. Shaw. Whose turn is it anyway? Latency and the organization of turn-taking in video-mediated interaction. *Journal of pragmatics*, 172:63–78, 2021. URL https://www.sciencedirect.com/science/article/pii/S0378216620302782. Publisher: Elsevier.

Graham Sewell and Laurent Taskin. Out of Sight, Out of Mind in a New World of Work? Autonomy, Control, and Spatiotemporal Scaling in Telework. *Organization Studies*, 36(11):1507–1529, November 2015. ISSN 0170-8406, 1741-3044. . URL http://journals.sagepub.com/doi/10.1177/0170840615593587.

Ashish Sharma, Adam S. Miner, David C. Atkins, and Tim Althoff. A Computational Approach to Understanding Empathy Expressed in Text-Based Mental Health Support, September 2020. URL http://arxiv.org/abs/2009.08441. arXiv:2009.08441 [cs].

Donghoon Shin, Soomin Kim, Ruoxi Shang, Joonhwan Lee, and Gary Hsieh. IntroBot: Exploring the Use of Chatbot-assisted Familiarization in Online Collaborative Groups. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, CHI '23, pages 1–13, New York, NY, USA, April 2023. Association for Computing Machinery. ISBN 978-1-4503-9421-5. . URL https://dl.acm.org/doi/10.1145/3544548.3580930.

Kristen M. Shockley, Allison S. Gabriel, Daron Robertson, Christopher C. Rosen, Nitya Chawla, Mahira L. Ganster, and Maira E. Ezerins. The fatiguing effects of camera use in virtual meetings: A within-person field experiment. *Journal of Applied Psychology*, 106(8):1137, 2021. URL https://psycnet.apa.org/fulltext/2021-77825-003.html?utm_source=summari. Publisher: American Psychological Association.

John Short, Ederyn Williams, and Bruce Christie. The social psychology of telecommunications. *(No Title)*, 1976. URL https://cir.nii.ac.jp/crid/1130282268777950720.

Stephen M. Shortell, Jill A. Marsteller, Michael Lin, Marjorie L. Pearson, Shin-Yi Wu, Peter Mendel, Shan Cretin, and Mayde Rosen. The Role of Perceived Team Effectiveness in Improving Chronic Illness Care. *Medical Care*, 42(11):1040–1048, 2004. ISSN 0025-7079. URL https://www.jstor.org/stable/4640854. Publisher: Lippincott Williams & Wilkins.

Peggy Simcic Brønn. Relationship outcomes as determinants of reputation. *Corporate Communications: An International Journal*, 12(4):376–393, 2007. Publisher: Emerald Group Publishing Limited.

Georg Simmel. *The Sociology of Georg Simmel*. Simon and Schuster, 1950. ISBN 978-0-02-928920-4. Google-Books-ID: Ha2aBqS415YC.

Georg Simmel. *Georg Simmel on individuality and social forms*. University of Chicago Press, 2011.

Kathryn Skivington, Lynsay Matthews, Sharon Anne Simpson, Peter Craig, Janis Baird, Jane M. Blazeby, Kathleen Anne Boyd, Neil Craig, David P. French, Emma McIntosh, Mark Petticrew, Jo Rycroft-Malone, Martin White, and Laurence Moore. A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. *International Journal of Nursing Studies*, 154:104705, June 2024. ISSN 0020-7489. . URL https://www.sciencedirect.com/science/article/pii/S0020748924000178.

Jaebong Son, Hyung Koo Lee, Sung Jin, and Jintae Lee. Content features of tweets for effective communication during disasters: A media synchronicity theory perspective. *International Journal of Information Management*, 45:56–68, 2019. Publisher: Elsevier.

Günter K Stahl, Martha L Maznevski, Andreas Voigt, and Karsten Jonsen. Unraveling the effects of cultural diversity in teams: A meta-analysis of research on multicultural work groups. *Journal of International Business Studies*, 41(4):690–709, May 2010. ISSN 0047-2506, 1478-6990. . URL http://link.springer.com/10.1057/jibs.2009.85.

Willem Standaert, Steve Muylle, and Amit Basu. How shall we meet? Understanding the importance of meeting mode capabilities for different meeting objectives. *Information & Management*, 58(1):103393, 2021. URL https://www.sciencedirect.com/science/article/pii/S0378720620303311. Publisher: Elsevier.

D. Sandy Staples and Lina Zhao. The Effects of Cultural Diversity in Virtual Teams Versus Face-to-Face Teams. *Group Decision and Negotiation*, 15(4):389–406, July 2006. ISSN 0926-2644, 1572-9907. . URL http://link.springer.com/10.1007/s10726-006-9042-x.

Kaveri Subrahmanyam and Patricia Greenfield. Online Communication and Adolescent Relationships. *The Future of Children*, 18(1):119–146, 2008. ISSN 1054-8289. URL https://www.jstor.org/stable/20053122. Publisher: Princeton University.

Heshan Sun and Ping Zhang. The role of moderating factors in user technology acceptance. *International Journal of Human-Computer Studies*, 64(2):53–78, February 2006. ISSN 1071-5819. . URL https://www.sciencedirect.com/science/article/pii/S1071581905000686.

Tianshu Sun and Sean J. Taylor. Displaying things in common to encourage friendship formation: A large randomized field experiment. *Quantitative Marketing and Economics*, 18(3):237–271, September 2020. ISSN 1573-711X. . URL https://doi.org/10.1007/s11129-020-09224-9.

Bryn L. Sutherland, Kristin Pecanac, Taylor M. LaBorde, Christie M. Bartels, and Meghan B. Brennan. Good working relationships: how healthcare system proximity influences trust between healthcare workers. *Journal of Interprofessional Care*, 36(3):331–339, May 2022. ISSN 1356-1820. . URL https://doi.org/10.1080/13561820.2021.1920897. Publisher: Taylor & Francis _eprint: https://doi.org/10.1080/13561820.2021.1920897.

Varsha Swamy. *Couple Conflict and Physical Health: The Moderating Role of Dyadic Processes in Romantic Relationships*. PhD Thesis, Colorado State University, 2021.

John Sweller. Cognitive load theory and educational technology. *Educational Technology Research and Development*, 68(1):1–16, February 2020. ISSN 1042-1629, 1556-6501. . URL http://link.springer.com/10.1007/s11423-019-09701-3.

Aaron Tabor, Ian CJ Smith, Scott Bateman, Josh Andres, Andrés Mejía Figueroa, and m. c. schraefel. 3rd body as starting point workshop: Exploring themes for inbodied

interaction research and design. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, pages 1–8, 2020.

E. Tan and A.L. Cox. Trusted teammates: Commercial digital games can be effective trust-building tools. pages 705–713, 2019. .

Hiroko Tanaka. The particle ne as a turn-management device in Japanese conversation. *Journal of Pragmatics*, 32(8):1135–1176, 2000. URL https://www.sciencedirect.com/science/article/pii/S0378216699000879. Publisher: Elsevier.

TeamBonding. City Build, 2024. URL https://www.teambonding.com/programs/city-build/.

Karl Halvor Teigen. Yerkes-Dodson: A Law for all Seasons. *Theory & Psychology*, 4(4): 525–547, November 1994. ISSN 0959-3543, 1461-7447. . URL https://journals.sagepub.com/doi/10.1177/0959354394044004.

Jacques Terken and Janienke Sturm. Multimodal support for social dynamics in co-located meetings. *Personal and Ubiquitous Computing*, 14(8):703–714, December 2010. ISSN 1617-4909, 1617-4917. . URL http://link.springer.com/10.1007/s00779-010-0284-x.

Christopher Terry and Jeff Cain. The Emerging Issue of Digital Empathy. *American Journal of Pharmaceutical Education*, 80(4):58, May 2016. ISSN 0002-9459. . URL https://www.sciencedirect.com/science/article/pii/S0002945923012160.

Rachel Tesler. The Effects of Storytelling and Reflexivity on Team Mental Models and Performance in Distributed Decision-Making Teams. 2011. URL https://etda.libraries.psu.edu/catalog/11812.

Rachel Tesler, Susan Mohammed, Katherine Hamilton, Vincent Mancuso, and Michael McNeese. Mirror, Mirror: Guided Storytelling and Team Reflexivity's Influence on Team Mental Models. *Small Group Research*, 49(3):267–305, June 2018. ISSN 1046-4964. . URL https://doi.org/10.1177/1046496417722025. Publisher: SAGE Publications Inc.

Rebecca A. Thomas, Richard E. West, and Jered Borup. An analysis of instructor social presence in online text and asynchronous video feedback comments. *The Internet and Higher Education*, 33:61–73, April 2017. ISSN 1096-7516. . URL https://www.sciencedirect.com/science/article/pii/S1096751617300301.

Catalina L. Toma and Jeffrey T. Hancock. Reading between the lines: linguistic cues to deception in online dating profiles. In *Proceedings of the 2010 ACM conference on Computer supported cooperative work*, pages 5–8, Savannah Georgia USA, February 2010. ACM. ISBN 978-1-60558-795-0. . URL https://dl.acm.org/doi/10.1145/1718918.1718921.

Catalina L. Toma, L. Crystal Jiang, and Jeffrey T. Hancock. Lies in the Eye of the Beholder: Asymmetric Beliefs about One's Own and Others' Deceptiveness in Mediated and Face-to-Face Communication. *Communication Research*, 45(8):1167–1192, December 2018. ISSN 0093-6502. . URL https://doi.org/10.1177/0093650216631094. Publisher: SAGE Publications Inc.

Maria Tomprou, Young Ji Kim, Prerna Chikersal, Anita Williams Woolley, and Laura A. Dabbish. Speaking out of turn: How video conferencing reduces vocal synchrony and collective intelligence. *PLoS One*, 16(3):e0247655, 2021. Publisher: Public Library of Science San Francisco, CA USA.

Carlo Tramontano, Christine Grant, and Carl Clarke. Development and validation of the e-Work Self-Efficacy Scale to assess digital competencies in remote working. *Computers in human behavior reports*, 4:100129, 2021. URL https://www.sciencedirect.com/science/article/pii/S2451958821000774. Publisher: Elsevier.

Khiet P. Truong and David A. van Leeuwen. Automatic detection of laughter. pages 485–488, 2005. . URL https://www.isca-archive.org/interspeech_2005/truong05_interspeech.html.

Jan M. van Bruggen, Paul A. Kirschner, and Wim Jochems. External representation of argumentation in CSCL and the management of cognitive load. *Learning and instruction*, 12(1):121–138, 2002. URL https://www.sciencedirect.com/science/article/pii/S0959475201000196. Publisher: Elsevier.

Tess van der Zanden, Maria B. J. Mos, Alexander P. Schouten, and Emiel J. Krahmer. What People Look at in Multimodal Online Dating Profiles: How Pictorial and Textual Cues Affect Impression Formation. *Communication Research*, 49(6):863–890, August 2022. ISSN 0093-6502. . URL https://doi.org/10.1177/0093650221995316. Publisher: SAGE Publications Inc.

Morry Van Ments. *The effective use of role-play: a handbook for teachers and trainers*. Kogan Page, London, 1st publ. edition, 1983. ISBN 978-0-85038-700-1.

Viswanath Venkatesh, Michael G. Morris, Gordon B. Davis, and Fred D. Davis. User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, 27(3): 425–478, 2003. ISSN 0276-7783. . URL https://www.jstor.org/stable/30036540. Publisher: Management Information Systems Research Center, University of Minnesota.

Katrien Verbert, Xavier Ochoa, Robin De Croon, Raphael A. Dourado, and Tinne De Laet. Learning analytics dashboards: the past, the present and the future. In *Proceedings of the Tenth International Conference on Learning Analytics & Knowledge*, pages 35–40, Frankfurt Germany, March 2020. ACM. ISBN 978-1-4503-7712-6. . URL https://dl.acm.org/doi/10.1145/3375462.3375504.

Roel Vertegaal. The GAZE groupware system: mediating joint attention in multiparty communication and collaboration. In *Proceedings of the SIGCHI conference on Human factors in computing systems the CHI is the limit - CHI '99*, pages 294–301, Pittsburgh, Pennsylvania, United States, 1999. ACM Press. ISBN 978-0-201-48559-2. . URL http://portal.acm.org/citation.cfm?doid=302979.303065.

Roel Vertegaal, Robert Slagter, Gerrit Van Der Veer, and Anton Nijholt. Eye gaze patterns in conversations: there is more to conversational agents than meets the eyes. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pages 301–308, Seattle Washington USA, March 2001. ACM. ISBN 978-1-58113-327-1. . URL https://dl.acm.org/doi/10.1145/365024.365119.

Ruth Wageman, J. Richard Hackman, and Erin Lehman. Team diagnostic survey: Development of an instrument. *The journal of applied behavioral science*, 41(4):373–398, 2005. Publisher: Sage Publications Sage CA: Thousand Oaks, CA.

Lena Waizenegger, Brad McKenna, Wenjie Cai, and Taino Bendz. An affordance perspective of team collaboration and enforced working from home during COVID-19. *European Journal of Information Systems*, 29(4):429–442, July 2020. ISSN 0960-085X, 1476-9344. . URL https://www.tandfonline.com/doi/full/10.1080/0960085X.2020.1800417.

Joseph B. Walther. Interpersonal Effects in Computer-Mediated Interaction: A Relational Perspective. *Communication Research*, 19(1):52–90, February 1992. ISSN 0093-6502, 1552-3810. . URL https://journals.sagepub.com/doi/10.1177/009365092019001003.

Joseph B. Walther. Computer-Mediated Communication: Impersonal, Interpersonal, and Hyperpersonal Interaction. *Communication Research*, 23(1):3–43, February 1996. ISSN 0093-6502, 1552-3810. . URL https://journals.sagepub.com/doi/10.1177/009365096023001001.

Joseph B. Walther. Theories of computer-mediated communication and interpersonal relations. *The handbook of interpersonal communication*, 4:443–479, 2011. URL http://www.commres.net/wiki/_media/42241_14.pdf.

Joseph B. Walther. Social Information Processing Theory (CMC). In Charles R Berger, Michael E Roloff, Steve R Wilson, James Price Dillard, John Caughlin, and Denise Solomon, editors, *The International Encyclopedia of Interpersonal Communication*, pages 1–13. Wiley, 1 edition, December 2015. ISBN 978-1-118-30605-5 978-1-118-54019-0. . URL https://onlinelibrary.wiley.com/doi/10.1002/9781118540190.wbeic192.

Joseph B. Walther and Ulla Bunz. The Rules of Virtual Groups: Trust, Liking, and Performance in Computer-Mediated Communication. *Journal of Communication*, 55(4):828–846, 2005. ISSN 1460-2466. . URL https://onlinelibrary.

wiley.com/doi/abs/10.1111/j.1460-2466.2005.tb03025.x. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1460-2466.2005.tb03025.x.

Joseph B. Walther, Tracy Loh, and Laura Granka. Let Me Count the Ways: The Interchange of Verbal and Nonverbal Cues in Computer-Mediated and Face-to-Face Affinity. *Journal of Language and Social Psychology*, 24(1):36–65, March 2005. ISSN 0261-927X, 1552-6526. . URL https://journals.sagepub.com/doi/10.1177/0261927X04273036.

Candace West and Don H. Zimmerman. *Small insults: A study of interruptions in cross-sex conversations between unacquainted persons*. Gender and psychology, Vol. IV. Routledge/Taylor & Francis Group, New York, NY, US, 2015. ISBN 978-0-415-66094-5. Pages: 75.

Ashley Whillans, Leslie Perlow, and Aurora Turek. Experimenting during the shift to virtual team work: Learnings from how teams adapted their activities during the COVID-19 pandemic. *Information and Organization*, 31(1):100343, 2021. URL https://www.sciencedirect.com/science/article/pii/S1471772721000099. Publisher: Elsevier.

Steve Whittaker. Things to Talk About When Talking About Things. *Human–Computer Interaction*, 18(1-2):149–170, June 2003. ISSN 0737-0024, 1532-7051. . URL https://www.tandfonline.com/doi/full/10.1207/S15327051HCI1812_6.

Brenda K. Wiederhold. Connecting Through Technology During the Coronavirus Disease 2019 Pandemic: Avoiding "Zoom Fatigue". *Cyberpsychology, Behavior, and Social Networking*, 23(7):437–438, July 2020. ISSN 2152-2715. . URL https://www.liebertpub.com/doi/abs/10.1089/CYBER.2020.29188.bkw. Publisher: Mary Ann Liebert, Inc., publishers.

We Are Wildgoose. Zombie Apocalypse Escape Room For Teams, 2024. URL https://wearewildgoose.com/uk/virtual-escape-room/zombie-apocalypse/.

Lawrence E. Williams and John A. Bargh. Keeping One's Distance: The Influence of Spatial Distance Cues on Affect and Evaluation. *Psychological Science*, 19(3):302–308, March 2008. ISSN 0956-7976, 1467-9280. . URL https://journals.sagepub.com/doi/10.1111/j.1467-9280.2008.02084.x.

Jeanne M. Wilson, Susan G. Straus, and Bill McEvily. All in due time: The development of trust in computer-mediated and face-to-face teams. *Organizational Behavior and Human Decision Processes*, 99(1):16–33, January 2006. ISSN 0749-5978. . URL https://www.sciencedirect.com/science/article/pii/S074959780500110X.

Anita Williams Woolley, Christopher F. Chabris, Alex Pentland, Nada Hashmi, and Thomas W. Malone. Evidence for a Collective Intelligence Factor in the Performance

of Human Groups. *Science*, 330(6004):686–688, October 2010. ISSN 0036-8075, 1095-9203. . URL https://www.science.org/doi/10.1126/science.1193147.

Maria Yakovleva, Richard R. Reilly, and Robert Werko. Why do we trust? Moving beyond individual to dyadic perceptions. *Journal of Applied Psychology*, 95(1):79–91, 2010. ISSN 1939-1854. . Place: US Publisher: American Psychological Association.

Chi-Lan Yang, Shigeo Yoshida, Hideaki Kuzuoka, Takuji Narumi, and Naomi Yamashita. Affective Profile Pictures: Exploring the Effects of Changing Facial Expressions in Profile Pictures on Text-Based Communication. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, CHI '23, pages 1–17, New York, NY, USA, April 2023. Association for Computing Machinery. ISBN 978-1-4503-9421-5. . URL https://dl.acm.org/doi/10.1145/3544548.3581061.

Longqi Yang, Sonia Jaffe, David Holtz, Siddharth Suri, Shilpi Sinha, Jeffrey Weston, Connor Joyce, Neha Shah, Kevin Sherman, C. J. Lee, Brent Hecht, and Jaime Teevan. How Work From Home Affects Collaboration: A Large-Scale Study of Information Workers in a Natural Experiment During COVID-19. *Nature Human Behaviour*, 6(1): 43–54, September 2021. ISSN 2397-3374. . URL http://arxiv.org/abs/2007.15584. arXiv:2007.15584 [cs].

Mon Yee, Myat Khine, Chong Ong, Aye Thidar, Ong Seong, and Myat Nyunt. Challenges and Opportunities of using Role-players in Medical Education: Medical Educator's Perspective. *Medical Research Archives*, 12, January 2024. . URL https://shorturl.at/fUMdr.

Zhou Yu, Dan Bohus, and Eric Horvitz. Incremental coordination: Attention-centric speech production in a physically situated conversational agent. In *Proceedings of the 16th Annual Meeting of the Special Interest Group on Discourse and Dialogue*, pages 402–406, 2015. URL https://aclanthology.org/W15-4652.pdf.

Brigitte Zellner. Pauses and the temporal structure of speech. In *Zellner, B.(1994). Pauses and the temporal structure of speech, in E. Keller (Ed.) Fundamentals of speech synthesis and speech recognition.(pp. 41-62). Chichester: John Wiley.*, pages 41–62. John Wiley, 1994. URL https://www.academia.edu/download/7525507/10.1.1.36.1414.pdf.

Alex Wuqi Zhang, Ting-Han Lin, Xuan Zhao, and Sarah Sebo. Ice-Breaking Technology: Robots and Computers Can Foster Meaningful Connections between Strangers through In-Person Conversations. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, CHI '23, pages 1–14, New York, NY, USA, April 2023. Association for Computing Machinery. ISBN 978-1-4503-9421-5. . URL https://dl.acm.org/doi/10.1145/3544548.3581135.