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An Integrated Investigation of Nostalgia Across Three Experimental Studies

by

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Abstract

I approach nostalgia, a frequently felt, social, and positive emotion, from three different perspectives, namely correlational, methodological, and temporal. In Chapter 1, I review the existing literature regarding nostalgia and its conceptual evolution over the years, the content of nostalgic reminiscences and the triggers that evoke nostalgic feelings, the psychological benefits of nostalgia, and important issues that have not yet been addressed in the current nostalgia literature. Then, I present my empirical papers, which have been compiled with the intention to contribute to the current literature in three distinct ways. In Chapter 2, I introduce my first study on the association between nostalgia, empathy, attachment, and facial emotion categorisation. In Chapter 3, I present my second empirical paper, in which I propose a novel nostalgia induction method using virtual reality and assess the efficacy of virtual environments in eliciting nostalgia experimentally. In Chapter 4, my third empirical paper, I explore the duration of both nostalgia and its psychological benefits in an experimental context. Additionally, I compare nostalgia induction methods in terms of their efficacy in prolonging nostalgia and its benefits. Finally, in Chapter 5, I discuss the key findings of my studies, implications, strengths, limitations, and directions for future research.

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List of A Research Thesis: Declaration of Authorship

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

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Definitions and Abbreviation

LIWC .... the Linguistic Inquiry and Word Count

VR .... Virtual Reality

ERT .... the Event Reflection Task

VRT .... the Virtual Reality Task

3D .... three-dimensional

VEs .... virtual environments

SNS .... the Southampton Nostalgia Scale

NI .... Nostalgia Inventory

QMEE .... the Questionnaire Measure of Emotional Empathy

BEES .... the Balanced Emotional Empathy Scale

rTMS .... Repeated Transcranial Magnetic Stimulation

BES .... the Basic Empathy Scale

PINE .... the Personal Inventory of Nostalgic Experiences

IRI .... the Interpersonal Reactivity Index

SNS-C .... nostalgia proneness in children

ASQ .... the Attachment Style Questionnaire

EEG .... electroencephalography

FDT .... Face Discrimination Task

2AFC .... two-alternative forced-choice

PPS .... Past Positive Scale

ZTPI .... the Zimbardo Time Perspective Inventory

NFS .... Nostalgia Functions Scale

QCAE .... the Questionnaire of Cognitive and Affective Empathy

SES .... the state-level empathy scale

JATOS .... Just Another Tool for Online Studies

FRT .... Face Rating Task

MET .... the Multifaceted Empathy Test

NPI .... Nostalgia Proneness Index

SAD .... Social Anxiety Disorder

NICE .... The National Institute for Health and Care Excellence

Threshold .... stimulus intensity at chance performance/sensitivity to the stimulus intensity

Slope .... how quickly the function changes at a threshold point/precision (or uncertainty) of the estimates

An Integrated Investigation of Nostalgia Across Three Experimental Studies

Chapter 1

Literature Review

1.1 Introduction

Nostalgia is defined as a sentimental longing or a wistful affection for the past (New Oxford Dictionary of English, 1998), and it has become a prominent topic of psychological research, since it is a pervasive and universal feeling (Sedikides et al., 2015; Wildschut et al., 2006). I aim to contribute to the existing literature by considering three underexplored aspects of nostalgia. Specifically, I have investigated its overall association with empathy, attachment security and facial emotion categorisation (Chapter 2), have developed a novel method for eliciting nostalgia using virtual reality, with the anticipation that, unlike other approaches, virtual reality possesses the potential to more realistically and closely recreate the environments people long to revisit (Chapter 3), and have explored its duration in an experimental context (Chapter 4).

In Chapter 1, I provide a comprehensive discussion of the literature on nostalgia, the variables of interest, and the gaps in the existing literature that are unexplored. I begin by providing information regarding the definition, content, and triggers of nostalgia, and the place of nostalgia among other emotions. I then explain the experimental induction methods that are used to evoke nostalgic feelings, the psychological benefits of nostalgia, and the literature regarding trait (i.e., dispositional) nostalgia. Lastly, I explore the literature that explains the possible relation between nostalgia, empathy, and facial emotion categorisation, and offer a brief overview of the present thesis.

1.2 Historical and Modern Interpretations of Nostalgia

The term nostalgia was first introduced in the late 17th century by the Swiss physician Johannes Hofer (1688/1934), formed of a combination of the words *nostos* (return, homecoming) and *algos* (pain, suffering). However, the concept of nostalgia dates back approximately 3,000 years, to Homer's classical work Odyssey, which revolves around the adventures of Odysseus, who, having fought in the Trojan War, has an intense yearning to return to his homeland, his wife, and his son. Though nostalgia was first associated with the capacity to find comfort in memories of the past, particularly those that include significant others, the conceptualisation of nostalgia has changed over the years in terms of its content (for a review see Sedikides, Wildschut & Baden, 2004).

Hofer (1688/1934) conceptualised nostalgia as a medical or neurological disease with physical and psychological symptoms that were experienced by Swiss mercenaries who had fought in faraway lands. High blood pressure, irregular heartbeat, anorexia, weeping, suicidal thoughts, hopelessness, and persistently contemplating home were among the numerous adverse symptoms (McCann, 1941), and this view continued throughout the 17th and 18th centuries (J. J. Scheuchzer, 1732).

In the late 19th century and the early 20th century, nostalgia was no longer regarded as a brain disorder, but as a psychiatric condition (Batcho, 1998), and a form of melancholia with symptoms of anxiety, sadness, insomnia, grief, and loss of appetite (Havlena & Holak, 1991; McCann, 1941). In the early- and mid-20th century, nostalgia was equated with homesickness, because nostalgic feelings were observed in those who lived far from their hometowns, such as immigrants, soldiers, seafarers, and boarding students (Cox, 1988; Rosen, 1975; Sedikides, Wildschut & Baden, 2004).

Although nostalgia had emerged as an emotion associated with negative conceptions, in the late 20th century nostalgia diverged from homesickness and gained a unique conceptual standing among both laypeople and researchers (Sedikides et al., 2008; Sedikides et al., 2015). While nostalgia refers to warm memories, the ‘good old days’, childhood, yearning (Davis, 1979), and joyful moments from the past (Kaplan, 1987), homesickness is found to be associated with insecurity (Fisher, 1989) and psychological problems, such as separation anxiety (Stroebe et al., 2002). Moreover, whereas homesickness relates to one’s hometown, nostalgia can refer to a wide range of aspects associated with the past such as events, places, and persons (Sedikides et al., 2008; Wildschut et al., 2006).

Currently, nostalgia has been defined as “a sentimental longing or wistful affection for the past, typically for a period or place with happy personal associations” (New Oxford Dictionary of English, 1998), and it is regarded to be a feeling that nearly everyone experiences frequently (Boym, 2001). Wildschut et al. (2006) provided evidence on the frequency of nostalgia by asking British undergraduates to report on how often they recall nostalgic memories by selecting one of seven options (i.e. “at least once a day”; “three to four times a week”; “approximately twice a week”; “approximately once a week”; “once or twice a month”; “once every couple of months”; and “once or twice a year”). The results revealed that almost 80% of the participants stated that they experience nostalgia at least once a week. Given the frequency of nostalgic feelings, researchers also considered addressing the content and triggers of nostalgia. However, its frequency of occurrence exhibits variability among individuals. Turner and Stanley (2021) found that the probability of experiencing nostalgia tends to rise with age, as indicated by higher reports of nostalgic episodes among older adults compared to middle-aged and young adults. Additionally, as nostalgia is a commonly experienced emotion, Hepper and colleagues (2014) investigated whether people from different cultures share similar perceptions of nostalgia. They gave a list of 35 features that define the prototype of nostalgia to participants from 18 countries, and asked to rate the degree to which each trait matched their own definition of nostalgia. The results revealed a cross-cultural agreement on how nostalgia is conceptualised, reinforcing the idea that nostalgia is a universal emotion transcending cultural boundaries.

1.3 Content and Triggers of Nostalgia

1.3.1 Content of Nostalgia

Researchers explored the themes a nostalgic recollection might have, by examining the content of nostalgic narratives. In an early investigation, Holak and Havlena (1992) evaluated the prevalent themes and topics of nostalgic contemplation. To assess that, they provided a brief description of nostalgia as expressed in the American Heritage Dictionary (i.e. “a longing for things, persons, or situations that are not present”; 1972). Then, they requested that participants provide three written accounts regarding the people, events, and objects involved in nostalgia by sharing as many details as possible. Results indicated that nostalgic narratives often include personally meaningful people, such as family members (e.g. parents, siblings, children), friends, and partners; specific objects or things that trigger nostalgic memories such as toys, antiques, and photographs; and special events such as holiday celebrations (e.g. Christmas, Easter, New Year’s Eve), birthday celebrations, graduations, and weddings. In a subsequent study, Holak and Havlena (1998) investigated the affective content that nostalgic narratives accommodate. To assess that, they instructed participants to describe the emotions associated with their nostalgic experiences, and then eight judges scored each nostalgic narrative using one of two emotional rating scales, the Pleasure-Arousal-Dominance scale (Mehrabian & Russel, 1974) and the Standardized Emotional Profile scale (Holbrook & Batra, 1987). The findings indicated that nostalgia includes intricate emotional reactions. Both positive and negative emotional components were reflected through the nostalgic narratives. Specifically, the positive component of nostalgia was characterised by emotions of tenderness, elation, and serenity, whereas the negative component included feelings of irritation, loss, and fear.

Wildschut et al. (2006, Study 1-2) replicated the above findings in a further study by content-analysing stories from issues 24-27 of the periodical *Nostalgia*. They found that nostalgic recollections, in which the self mostly emerges as the main character, centred on close relationships with significant others, personally meaningful life events, objects and pets, and certain places. Moreover, they indicated that although nostalgic memories did not always have joyful content, they elicited more positive affect (compared to negative affect), with a hint of ambiguity, since unpleasant experiences are mitigated or redeemed by future accomplishments.

For a detailed investigation of the lay conceptions of nostalgia to generate a prototype of laypersons' comprehension, Hepper and her colleagues (2012) conducted seven studies. In Study 1, the aim was to establish a set of characteristic features of nostalgia. Among all the characteristics, 35 features were identified through the coding of descriptions by two independent judges. Then, in Study 2, participants assessed the centrality or peripherality of each feature, indicating the degree of association with their perception of nostalgia. They reached 18 central and 17 peripheral features of nostalgia, with central features involving verbs such as missing and longing, and peripheral features including aspects such as comfort/warmth, change, calm/relaxed, and regret. In Study 3, they evaluated how feature centrality affected recall. Participants were presented with statements containing either a central or peripheral feature and then engaged in recall and recognition tasks, with central features being more readily remembered and incorrectly identified compared to peripheral ones. In Study 4, they displayed central, peripheral, and nostalgia-free features to participants. The task required participants to rapidly respond with a 'Yes' or 'No' to the prompt, "Is this a feature of nostalgia?". Participants consistently and swiftly identified central features as associated with nostalgia more often than peripheral or control features. They further investigated the influence of central and peripheral features on perceived nostalgia by vignettes describing a character's autobiographical event in Study 5. Lastly, in Study 6 and Study 7, participants composed narratives about a nostalgic or ordinary event, subsequently evaluating narratives across all 35 features. Ratings indicated that nostalgic events, in comparison to ordinary ones, scored higher on central features rather than peripheral or control features. Regardless of age, the use of central features to evoke a personal memory was found to result in elevated levels of actual nostalgia and its intrapersonal benefits.

In a further investigation, Wildschut, Sedikides, and Robertson (2018, Experiment 1) considered the content of nostalgic narratives in older adulthood, and examined the nostalgic (compared to ordinary) narratives of 40 older adults using the Linguistic Inquiry and Word Count (LIWC; Pennebaker et al., 2007). The results indicated that nostalgic narratives incorporated more social processes than ordinary narratives. In addition, they evaluated the usage of pronouns and found that nostalgic accounts contain fewer first-person singular pronouns and more first-person plural pronouns than ordinary narratives, suggesting reduced self-focus and increased social interactions.

All in all, nostalgic narratives typically involve meaningful interactions between one's social circle within a momentous context, and thus they capture a social theme (Holak & Havlena, 1992; Holak & Havlena, 1998; Wildschut et al., 2006, Studies 1-2). Individuals tend to remember nostalgic memories with rose-tinted glasses, as nostalgia involves meaningful and fond memories in particular, even if the memories involve loss or a tinge of longing (Hepper et al., 2012).

1.3.2 Triggers of Nostalgia

Since nostalgia is replete with social themes, social interactions with one's social surroundings may naturally evoke nostalgic sentiments; however, research has demonstrated that several other, more precise, sources also qualified as external or internal nostalgia-stimulating factors (Batcho, 2008; Sedikides et al., 2015; Wildschut et al., 2006; Wildschut & Sedikides, 2022). External triggers included evocative objects of a person's hometown or childhood (Holbrook & Schindler, 1996; Holbrook & Schindler, 2003), sensory experiences (i.e. music or songs: Barrett et al., 2010; Reid et al., 2022; scents: Reid et al., 2015; Routledge et al., 2011; taste-oriented associations: Supski, 2013; Zhou et al., 2012), song lyrics (Batcho et al., 2008; Cheung et al., 2013), and adverse weather conditions (i.e. wind, rain: Van Tilburg, Sedikides & Wildschut, 2018; coldness: Zhou et al., 2012). Whereas, dysphoric moods such as loneliness (Wildschut et al., 2010; Zhou et al., 2008), boredom (Van Tilburg, Igou & Sedikides, 2013), negative affect (Barrett et al., 2010; Wildschut et al., 2006), self-discontinuity (Sedikides et al., 2008; Sedikides et al., 2015), and life meaninglessness (Routledge et al., 2011; Routledge et al., 2012) can be exemplified as internal triggers. In all, nostalgia, characterised by its subjective nature, originates from the intricate interplay of individual memories and emotions, that may be associated with a wide range of stimuli. Furthermore, nostalgia is inherently a social emotion, frequently manifesting itself during social interactions or dialogues with one's social surroundings (Sedikides et al., 2015.; Wildschut et al., 2006). Consequently, nostalgia is triggered by a wide range of phenomena mentioned above.

Studies have also noted that certain stimuli tend to bring up nostalgic memories more than others. For example, negative affect was found to be the most commonly reported trigger, while loneliness was the most frequently reported distinct affective state within this category (Wildschut et al., 2006). Wildschut et al. (2006, Study 3) supported these findings by randomly assigning participants to a negative, neutral, or positive mood condition, and instructing participants to complete the Nostalgia Inventory (Batcho, 1995), which was used to examine how nostalgic they felt about 18 aspects of their past. The results indicated that participants in the negative mood condition felt more nostalgic about their past compared to those in the neutral and positive mood conditions, which suggests that negative affect elevates nostalgic feelings.

1.3.3 Summary

In summary, current evidence suggests that nostalgic narratives typically entail the recollection of personally meaningful life events that focus on the self in a social context. Nostalgic memories include mainly positive experiences, although they may also involve losses and an irretrievable past. However, in nostalgic recollections, the positive experiences outweigh the negatives. In addition to being naturally triggered by social encounters, nostalgia can be stimulated by a variety of environmental (e.g. music, scents, evocative objects) and subjective (e.g. negative affect, loneliness) elicitors.

1.4 Nostalgia as an Emotion

Emotions are adaptive responses for social living, serving as vital signals for changes in our environment and motivating us to adapt and address these changes (Darwin, 1872/1965; Kuppens, 2015; Scherer, 2009). Although initial beliefs suggested that emotions are brief responses to specific situations (Ekman, 1984), empirical evidence confirmed that emotions are complex dynamic states that fluctuate in a continuum, and can last from only a few seconds to several hours or longer (Gilboa & Revelle, 1994; Scherer & Wallbott, 1994; Verduyn et al., 2009; Verduyn et al., 2012). How individuals respond to environmental changes and control their emotions is reflected in the patterns of emotional fluctuations (Larsen, 2000). In order to comprehensively depict emotions, researchers examined their dynamic nature and explored the structure of emotions, which pertains to an organization of the emotional domain derived from empirical evidence or theoretical constructs (Hemenover, 2003; Kuppens et al., 2006; Kuppens & Verduyn, 2017). Various frameworks have been proposed (Kuppens et al., 2006), with two prominent traditions being the discrete emotions approach and the dimensional approach. In the discrete approach, the premise is that several (basic) discrete emotions exist, each displaying qualitative distinctions in terms of antecedent conditions, physiological correlates, subjective experience, and/or expressive behaviour (e.g., Ekman, 1999; Oatley & Johnson-Laird, 1990). On the other hand, the dimensional approach primarily concentrates on the subjective experience of emotions at a state or trait level. Nevertheless, researchers have not reached a consensus on a singular structure. Instead, they offer various explanations, employing categories, dimensions, bipolar or unipolar concepts, simple structures, and circumplex models of emotion based on their respective approaches (Russell & Feldman Barrett, 1999; Russell, 1980; Watson, 2000).

As nostalgia is recognised as an emotion, scholars have conducted investigations into its affective signature within this framework, along with the properties of nostalgia as an emotion, its similarities and differences with other emotions, and its position within the spectrum of emotions. There have been divergent opinions on the emotional structure of nostalgia. While some researchers considered nostalgia to be an unpleasant emotion, as it evokes memories related to an intense longing for an irretrievable past (Best & Nelson, 1985; Hertz, 1990; Peters, 1985), others had the view that nostalgia is a positive emotion since it depicts a “warm feeling about the past” (Kaplan, 1987) and is associated with positive affect (Batcho, 1995, 1998; Holak & Havlena, 1998). In the current literature, nostalgia is viewed as a predominantly positive emotion with some ambivalence (Davis, 1979; Sedikides et al., 2004; Wildschut et al., 2006).

For further investigation, Hepper et al. (2012) demonstrated a prototype of laypersons' comprehension of nostalgia. In Study 1, participants were instructed to indicate all of the qualities they believed to be characteristics of nostalgia. Two independent coders then categorised the descriptions into 35 features. Next, in Study 2, another set of participants judged each feature considering them as central or peripheral, and how closely it connected to their perception of nostalgia (for details, see Hepper et al., 2012, Study 2). The results revealed that both positive (e.g. fondness, happiness, warmth, calm) and negative (e.g. missing, regret, loneliness) characteristics exist in central and peripheral features. However, the participants’ views on nostalgia considering both central and peripheral features were predominantly positive. In another study, Hepper et al. (2014) replicated the results above in a cross-cultural context. A total of 1,704 participants from 18 countries were provided with a list of 35 defining prototypical characteristics of nostalgia (i.e. the prototypes that were identified in the USA/UK by Hepper et al., 2012), and were instructed to assess how closely each characteristic corresponded to their conception of nostalgia. The findings demonstrated that, in all nations, the participants assessed previously identified central (compared to peripheral) characteristics as more indicative of nostalgia, and there was stronger interindividual agreement about core (compared to peripheral) characteristics. Together, these results suggested that the majority of nostalgic recollections were fond, happy, and rose-tinted reflections of the past, although they occasionally included bittersweet feelings, longing, grief, the death of a valued person, or an irretrievably lost event. Based on those findings, the emotion of nostalgia was identified as having a mixed valence but mostly being pleasant and past-oriented (see also Batcho, 2013; Stephan et al., 2014). In addition to these emotional features, it has also been found that nostalgia is a universal emotion. The conclusion that nostalgia is a universal emotion is supported by the findings which demonstrate that there is a cross-cultural agreement about the conceptions of nostalgia and a similar understanding of nostalgia across various cultures (Hepper et al., 2014; Sedikides et al., 2015).

A further characteristic of nostalgia as an emotion is its self-relevant nature. In six studies, Van Tilburg, Wildschut and Sedikides (2018) employed multidimensional scaling to compare nostalgia with 10 self-relevant emotions to investigate nostalgia's position among those self-related emotions. In Studies 1-4, they asked participants to compare and rate emotions against each other based on their similarities and differences (self-compassion, pride, guilt, embarrassment, shame, gratitude, inspiration, hurt feelings, passion, and unrequited love). The results demonstrate a two-dimensional model, with one dimension representing valence and the other representing arousal. Nostalgia was distinguished by its positive valence and low arousal. Furthermore, guilt, shame, and embarrassment were perceived as the most dissimilar emotions to nostalgia, while self-compassion, gratitude, and pride ranked as the most similar.

Later, Van Tilburg et al. (2019) explored the cognitive appraisal profile of nostalgia (i.e. evaluations of an incident or circumstance in which an emotion is experienced; Frijda, 1988, 1993; Frijda, Kuipers & Ter Schure, 1989), and investigated nostalgia's position among emotions as well as the degree to which nostalgia resembles or varies from these comparable emotions. To investigate that, Van Tilburg et al. (2019) first asked participants to report on an autobiographical incident from their past, then rated that recollection based on a number of appraisal items (e.g. irretrievable loss, temporal distance, pleasantness, uniqueness, and reflection). They then asked individuals to identify the degree to which they experienced nostalgia and 31 other comparative emotions (e.g. longing, pride, sadness, tenderness, bitterness, gratitude) in reaction to the recalled incident. The findings demonstrated that nostalgia has a distinct appraisal profile compared to the other emotions, with participants perceiving nostalgia as unique, pleasant, irretrievably lost, and temporally distant. Considering approach-avoidance models of emotion, Stephan et al. (2014) emphasised the motivational direction of nostalgia, elucidating its regulatory function within the avoidance and approach motivational systems. In five studies, they demonstrated that nostalgia enhanced approach motivation and provided insight into the role of nostalgia in regulating the human motivation system.

When people engage in nostalgic thoughts, they symbolically reinforce the social bonds between themselves and their social surroundings (Wildschut et al., 2006). Supportively, Abeyta et al. (2015a) investigated sociality in nostalgic feelings by instructing participants to recall either a nostalgic or an ordinary memory from their past. Then, three coders rated the narratives and demonstrated the social content, such as social interactions and relationships. Thus, based on the social content that emerged through the nostalgic reflections, besides being a self-relevant emotion, researchers regarded nostalgia as a social emotion (Batcho, 2013; Hepper et al., 2012; Sedikides & Wildschut, 2018; Sedikides & Wildschut, 2020; Wildschut et al., 2006; Zhou et al., 2012).

In summary, although not all studies lend support to the view of nostalgia as a positive emotion, nostalgia has been demonstrated as a bittersweet and ambivalent (Hepper et al., 2021; Wildschut et al., 2006), yet predominantly positive (Batcho, 1998; Hepper et al., 2012; Sedikides & Wildschut, 2016; Wildschut et al., 2006), past-oriented (Hepper et al., 2012), universal (Hepper et al., 2014; Sedikides et al., 2015), self-relevant (Van Tilburg et al., 2018; Wildschut et al., 2006), low arousal (Van Tilburg et al., 2018), uniquely appraised (Van Tilburg et al., 2019), and social emotion (Batcho, 2013; Hepper et al., 2012; Sedikides & Wildschut, 2018; Sedikides & Wildschut, 2020; Wildschut et al., 2006; Zhou et al., 2012).

1.5 Experimental Inductions of Nostalgia

To examine the effectiveness of nostalgia in experimental settings, researchers have developed numerous induction techniques to manipulate nostalgia. Several different evocative methods have been used, such as vivid autobiographical writing tasks, music, song lyrics, food, scents, and visual imagery tasks. In addition to those methods, I have proposed virtual reality-based nostalgia induction, as will be explained in Chapter 3.

1.5.1 Event Reflection Task (ERT)

The Event Reflection Task (ERT; Sedikides et al., 2015) is the most commonly used validated method for inducing nostalgia in controlled laboratory settings, and it was initially proposed by Wildschut et al. (2006, Study 5, 6) to assess the psychological benefits of nostalgia. Generally, the ERT begins by assigning participants to either a nostalgic or an ordinary condition. Participants in the nostalgia condition are provided with a description of nostalgia and instructed to recall a nostalgic memory from their past ("According to the New Oxford Dictionary of English, nostalgia is defined as a sentimental longing for the past. Please think of a nostalgic event in your life. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel?"), those in the ordinary condition are asked to bring to mind an ordinary autobiographical event that happened in the past ("Please bring to mind an ordinary event in your life. Specifically, try to think of a past event that is ordinary. Bring this ordinary experience to mind. Immerse yourself in the ordinary experience. How does it make you feel?"). Following those instructions, participants list keywords that reflect the event that they recalled, and spend some time writing about the event using vivid and descriptive details.

One limitation concerning the ERT manipulation is its short duration. It is probable that a single manipulation session may not adequately reflect the entire nostalgic experience. It may have been difficult to evoke nostalgic memories within such a brief experience. Another potential limitation of this method may be its instructions to recall past events in both experimental conditions (i.e. nostalgia vs ordinary). It can be difficult to differentiate between nostalgic and regular recollections; even recalling an ordinary experience from the past might evoke nostalgia. Additionally, several reviews have been conducted on mood and emotion elicitation to explore the effectiveness of various techniques, although most of the methods were found to be successful. Lench, Flores, and Bench (2011) performed a meta-analysis to investigate this, aiming to explore the factors that affect the effectiveness of techniques for eliciting emotions by examining the effect sizes. They considered the film, pictures, priming, music, Velten, imagination, reading text, real-life experiences, autobiographical recall and behavioural elicitations. The findings revealed that picture presentations were overall the most effective elicitor of discrete emotions while autobiographical recall was the least effective elicitor. A more recent meta-analysis also evaluated the affect-induction procedures regarding their effectiveness, considering Velten, imagination, autobiographical recall, film, reading a story, music/sounds, pictures, feedback, coping challenge, manipulation of face/body, jokes/cartoons/odour, and video recording as elicitors (Joseph et al., 2020). When comparing the effect sizes of different types of affect-induction procedures, the findings indicated that the film presented with instructions showed the strongest effect size, followed by facial expressions and reading with instructions. Although it is important to note those limitations, previous research has demonstrated that the ERT is a successful way to elicit nostalgia: participants who are instructed to bring to mind a nostalgic event feel more nostalgic than those in the control condition (Cheung et al., 2013; Cheung et al., 2016; Sedikides et al., 2015; Vess et al., 2012; Wildschut et al., 2006; Zhou et al., 2012).

1.5.2 Music-Evoked Nostalgia

Considering music as an external trigger, researchers explored whether they could use music as a way to manipulate nostalgia (Batson et al., 1983; Cheung et al., 2013; Evans et al., 2022; Stephan et al., 2015; Zhou et al., 2012). To illustrate, Cheung et al. (2013) presented participants with either a nostalgic or a control song. As they intended, the participants who listened to the nostalgic song reported greater levels of nostalgia than the ones who listened to the control song. In a more recent study, Evans et al. (2022, Study 3) induced romantic nostalgia through music. They instructed the participants to think of a song that either reminded them of a romantic relationship and made them nostalgic, or a song that they enjoyed which was irrelevant to their relationship. In the final phase, they asked participants to specify a song they remembered, and played the entire song from Spotify. The results revealed that they successfully induced romantic nostalgia through music, as the participants in the nostalgia condition (vs. control) reported higher levels of nostalgia. Although these studies were able to differentiate the nostalgia and control conditions, some possible limitations should be pointed out. A notable limitation may cover the idiosyncrasy of individuals. Since music preference is changeable and personal (Rentfrow & Gosling, 2003), it may be challenging to create a robust nostalgia manipulation through music which appeals to each culture, age, and personality at the same time.

1.5.3 Song Lyrics

In another music-based nostalgia manipulation, Cheung et al. (2013, Study 4) designed an experiment to evaluate the use of song lyrics as a nostalgia manipulation. They aimed to arouse nostalgia by presenting participants with song lyrics that were previously identified by the participants as nostalgic (vs. the control lyrics). Results demonstrated that reading nostalgic lyrics significantly increased nostalgia levels among participants compared to those reading control lyrics.

1.5.4 Scent and Food-Evoked Nostalgia

There is a strong association between various scents and memories, so scent plays an important role in the recollection of past experiences (Waskul & Vannini, 2008). Accordingly, Reid et al. (2015) conducted a study in which each participant was asked to complete a questionnaire that measured trait nostalgia, smell a variety of scents (e.g. money, lavender flowers, apple pie, and others) selected from a pilot study, and described how nostalgic they felt afterwards. Those with higher levels of trait nostalgia (compared to low) reported experiencing more scent-evoked nostalgia. In another study, Reid et al. (2022) extended those findings and they also investigated the role of food in evoking nostalgia in three studies. Across these three studies, it was shown that food is an evocator of nostalgic recollections. However, it is important to emphasise that, as with the induction of music, memories evoked by scents or food are based on idiosyncratic experiences.

1.5.5 Visual Imagery Task

Verplanken (2012) developed a visualisation-based nostalgia induction based on the ERT. For the nostalgia condition, he first provided the formal dictionary definition of nostalgia, and asked participants to recall a nostalgic memory from their past by visualising the details related to the memory. Next, he instructed participants to describe details regarding (i) a place, situation or event that makes them feel nostalgic; (ii) things, people, sounds, smells; and (iii) how it makes them feel being there. A similar assignment was given to participants in the control condition; however, instead of asking them to recall a nostalgic recollection, they were asked to visualise an ordinary event with the same instructions. The results revealed that the visual imagery task was successful in producing nostalgia.

1.5.6 A New Virtual Reality Nostalgia Induction?

Although the methods presented above have been validated and used successfully to manipulate nostalgia, they also have limitations. In addition, when I considered the meta-analyses on emotion elicitation, I realised that the presentation of pictures, facial expressions and films were effective elicitors in particular (Joseph et al., 2020; Lench et al., 2011). I, therefore, intended to develop a novel method via virtual reality by using immersive visuals to produce a stronger sense of nostalgia (see Chapter 3).

Virtual Reality (VR). VR is a technology that involves a set of equipment, a head-mounted display, controllers, and one or more position trackers (Emmelkamp & Meyerbröker, 2021; Riva, 2022) to present computer-generated three-dimensional (3D) virtual environments (VEs). As Witmer and Singer (1998) highlighted, the effectiveness of VEs depends on three main elements: involvement, immersion, and presence. They defined these as follows: (i) involvement as a psychological state that results from focusing on a set of stimuli or related actions and events; (ii) immersion as being engaged in the experience emotionally and mentally; and (iii) presence as the feeling of “being there” as a part of the virtual environment. The sense of presence, which creates a subjective experience that gives the user the impression that they are really there, is what particularly sets VR apart from other technological tools (Riva, Davide & Ijsselsteijn, 2003; Riva et al., 2016). Based on the explanations, arguably, the main benefit of VR as an experimental tool is its capacity to present visual stimuli in three dimensions (Wilson & Soranzo, 2015). Nevertheless, as VR technology has progressed, developers have begun to integrate multiple sensory inputs that allow users to experience haptic, auditory, olfactory, and physical sensations (Bohil, Alicea & Biocca, 2011; Navarre et al., 2005). Although there were a number of limitations on the use of early-generation VRs due to the high expense of VR equipment, uncomfortable design of the headsets, and low resolution (Lindner et al., 2017; Rebenitsch & Owen, 2016), with technical advancements it has gained rapid popularity and has become a useful tool for scientific research. Especially, the use of VR has enabled the production of innovative complicated scenarios, offering three-dimensional immersive presentations of life-like environments, providing better control for the researcher over stimulus presentation, and allowing researchers to examine the subject's behaviour in a laboratory setting (Diniz Bernardo et al., 2021; Lindner et al., 2017; Riva, Wiederhold & Mantovani, 2019; Wilson & Soranzo, 2015). It is important to note that presenting reasonably realistic and immersive environments may require expensive specialised equipment and technical knowledge to operate complex software (Bown, White & Boopalan, 2017; Newman et al., 2022). However, due to ongoing enhancements, including the increased high-resolution of visual units, ready-to-use virtual environments/items, and reasonably priced equipment, VR has become user-friendly and accessible (Aguinas, Henle & Beaty, 2001; Berni & Borgianni, 2020; Bown, White & Boopalan, 2017). Indeed, in psychology, VR has emerged as an efficient experimental tool for the assessment, understanding, and treatment of mental health disorders (Emmelkamp et al., 2001; Emmelkamp & Meyerbröker, 2021; Freeman et al., 2017; Riva et al., 2016, 2019).

Studies have also provided compelling evidence regarding the benefits of VR for emotion induction, and it has been shown that VR is an effective method for mood and emotion manipulation (Diniz Bernardo et al., 2021; Felnhofer et al., 2015; Pavic et al., 2022; Rivu et al., 2021). To illustrate, some of the successful examples of mood induction are as follows: fear, with a 30-foot unpredictable spider; angst, with a virtual world that includes clanging clocks and fanged buildings (Morie, 2006); awe, through viewing the earth from a deep space perspective (Chirico et al., 2016); joy, with a calm, quiet, sunny environment; anger, with a clearly visible construction machine and sound of heavy construction work; boredom, with a dull park scene; anxiety, with a gloomy night-time park scenario (Felnhofer et al., 2015; results did not yield a significant elicitation of sadness); and relaxation, with natural scenes such as forests (Anderson et al., 2017; Baños et al., 2012; Browning et al., 2020). While VR has demonstrated remarkable success in inducing a wide range of emotions such as fear, anger, joy, awe, boredom, relaxation, and anxiety, certain emotions might be more elusive in VR-based studies. Notably, emotions like shame, compassion, disappointment, distress, depression, hate, confusion, and regret have not been frequently reported in the literature (Somarathna, Bednarz & Mohammadi, 2022). Nonetheless, considering that VR is a successful tool for eliciting emotions, I explored the efficacy of nostalgic virtual environments presented via VR as a novel induction technique (Chapter 3).

1.5.7 Summary

The research reviewed thus far has revealed that to study the efficacy of nostalgia in experimental settings, researchers have created a variety of induction procedures. All of these established techniques prepared the path for experimental research into the psychological benefits of nostalgia.

1.6 The Psychological Benefits of Nostalgia

With the advancement of experimental methods to evoke nostalgia, scholars have begun to explore the possible psychological benefits that nostalgia may serve in controlled laboratory settings. Indeed, they have demonstrated the positive impact that nostalgia can have in promoting a variety of key psychological health benefits, and they categorised those benefits as existential, self-related, and social (Sedikides et al., 2015; Wildschut & Sedikides, 2020; Wildschut & Sedikides, 2022).

1.6.1 Existential Benefits

As discussed above, when people nostalgise, they tend to focus on personally meaningful events (e.g. personal celebrations, and traditional gatherings) that involve significant others in their lives (Wildschut et al., 2006). Recalling such memories is likely to provide a meaningful life (Arndt et al., 2013; Lambert et al., 2010). In fact, in five studies, Lambert et al. (2010) explored the influence of familial relationships as a determinant of perceived meaning in life. They assessed whether individuals would identify family as a primary source of meaning, and evaluated whether family closeness and support would strongly predict a sense of meaning. The results revealed that 68% of participants reported family to be the one thing that brought the most meaning to their lives, with friendships being the next most commonly cited source of meaning. Given that nostalgia is abundant in social content and centres around the connection between oneself and significant others, scholars have extensively examined nostalgia as an existential asset contributing to the creation of meaning in life.

Routledge et al. (2011) conducted an experimental study to examine whether manipulated nostalgia influences the perception of meaning in life. They implemented a music-evoked nostalgia induction using song lyrics, and they measured meaning in life via the Presence of Meaning in Life subscale of the Meaning in Life Questionnaire (Steger et al., 2006). The results indicated that participants in the nostalgia condition (vs. control) reported greater levels of meaning. In a subsequent study, Routledge et al. (2012) tested nostalgia's role in bolstering meaning in life in comparison with two modes of autobiographical thought: thinking about a desired future experience and remembering a nostalgic experience. Results replicated the previous study: thinking about a nostalgic (vs. desired future) experience increased the perceived presence of meaning. Van Tilburg, Igou, and Sedikides (2013, Study 5) revealed similar findings, such that participants in the nostalgia condition stated higher meaning in their lives than the participants in the control condition.

When one's perception of meaning in life is boosted by nostalgia, it also buffers against death-related concerns (Juhl et al., 2010). A study by Routledge, Arndt, Sedikides, and Wildschut (2008) induced existential threat by activating participants' death thoughts, and measured trait nostalgia and the perception of the meaning in life. The findings showed that although thinking about mortality resulted in lower life satisfaction, participants with a higher trait nostalgia reported a greater perception of meaning in life. All in all, nostalgia provides a more positive perspective on the past, which may lead to a more meaningful perception of life (Sedikides & Wildschut, 2018).

1.6.2 Self-Oriented Benefits

Nostalgia is a self-relevant and fundamentally positive emotion, and in nostalgic reflections, the self is the main character. Based on this, researchers have investigated the self-related benefits of nostalgia, and they have provided evidence that nostalgia generates positive affect, associated authenticity, elevates self-esteem, increases optimism, and fosters self-continuity.

Positive Affect. Wildschut et al. (2006, Study 5, 6) examined the functional utility of nostalgia and suggested that positive affect is among its self-related benefits. To test that, they randomly assigned participants to the nostalgia versus control conditions, and administered the 20-item Positive and Negative Affect Scheme (Watson, Clark & Tellegen, 1988). The results revealed that participants in the nostalgia condition (vs. control condition) reported more positive affect.

Authenticity. Authenticity is defined as the sense of being one's genuine self (Lenton et al., 2013; Sedikides et al., 2017; Sedikides et al., 2019). Drawing from the self-related nature of nostalgia, scholars proposed that invoking personally significant and influential past experiences could enhance the sense of authenticity. In support of this view, Stephan et al. (2012) experimentally induced nostalgia and evaluated authenticity. The findings demonstrated that participants in the nostalgia condition stated greater levels of authenticity compared to ordinary and positive autobiographical event conditions. In another study, Kelley et al. (2022) addressed the link between trait nostalgia and psychological well-being, through authenticity. cross four studies, they illustrated the association between nostalgia, psychological well-being, and authenticity. Furthermore, the results indicated that authenticity played a mediating role in the relationship between nostalgia and psychological well-being.

Self-Esteem. Individuals have the motivation to maintain a positive view of self (Steele, Spencer & Lynch, 1993), and nostalgia aids in maintaining a positive self-image (Sedikides & Alicke, 2012). Additionally, nostalgia leads to the recollection of meaningful and positive memories of events, such as graduations and birthdays, that are likely to boost self-esteem (Holak & Havlena, 1992). In support of this view, Wildschut et al. (2006, Study 5, 6) manipulated nostalgia by instructing participants to recall either a nostalgic or an ordinary event from their past, and measured self-esteem with a 2-item scale (“significant”, and “high self-esteem”) and the Rosenberg Self-Esteem Scale (Rosenberg, 1965). The results indicated that, relative to the participants in the control condition, those in the nostalgia condition evinced higher levels of self-regard. In another study, Hepper et al. (2012, Study 7) induced nostalgia experimentally using prototypical features (i.e. with a list of either central features for the nostalgia condition or peripheral features for the control condition) and instructed participants to bring to mind an event that is marked by those features. Subsequently, they asked participants to report their level of self-esteem (e.g. “I have many positive qualities”). In line with the previous findings, individuals in the nostalgia condition (vs. control) displayed higher self-esteem. The positive effect of nostalgia on self-esteem may stem from its ability to increase positive self-attributions and decrease self-esteem threats (Kaplan, 1987; Vess et al., 2012).

Optimism. Researchers have demonstrated that individuals who experience nostalgia have an increased sense of meaning in life and self-esteem, resulting in more optimistic predictions for the future (Cheung et al., 2013; Evans et al., 2021; Sedikides, Wildschut & Stephan, 2018). In particular, Cheung et al. (2013, Study 1) examined whether nostalgic narratives contain signs of optimism. To test that, they created two experimental conditions (nostalgia vs. ordinary) via the Event Reflection task, and then evaluated the narratives in terms of the proportion of optimism-related words. The results highlighted that individuals in the nostalgic condition showed greater optimism compared with those in the control condition, and nostalgic memories often include optimism-related words (e.g. hope, determined, optimistic). In other studies, nostalgia was induced by music (Cheung et al., 2013, Study 4) and scent (Reid et al., 2015). It was concluded that higher levels of music- or scent-evoked nostalgia predicted greater levels of optimism.

Self-Continuity. Self-discontinuity, a dissociation between one's past and present self, may lead to uncertainty, worry, depression, and negative mood (Milligan, 2003). However, researchers have argued that nostalgia may counteract self-discontinuity by increasing self-continuity (i.e. a connection between past and present selves) (Sedikides et al., 2008; Sedikides et al., 2015), because nostalgia acts as a bridge between past and present. Sedikides et al. (2015, Study 4) demonstrated this point with an experiment in which participants were assigned to nostalgia and control conditions, and then completed a self-continuity measure. The results indicated that participants who recalled a nostalgic event (vs. ordinary) reported greater self-continuity. In another study, Reid et al. (2015) administered a scent-elicited nostalgia induction, and asked participants to complete a questionnaire which involved items related to self-continuity (e.g. “connected with my past”). They also found that scent-evoked nostalgia increases self-continuity. In all, nostalgia promotes self-continuity.

1.6.3 Social Benefits

The need to belong is defined as a “need for frequent, nonaversive interactions within ongoing relational bonds” (Baumeister & Leary, 1995, p. 497). Individuals have the motivation to participate in social groups and the desire to keep their social connections throughout their lives (Mann, 1980). Additionally, they naturally seek out and endeavour to form close, meaningful relationships with others (Baumeister & Leary, 1995). Given that nostalgia is regarded as an enabler of a sense of belongingness, since nostalgic narratives often centre on social interactions with family members, friends, and romantic relationships (Abeyta, Routledge & Juhl, 2015b; Sedikides et al., 2016), there are good reasons to hypothesise that nostalgia provides social benefits. Studies have shown that nurturing social connectedness, decreasing attachment anxiety and attachment avoidance, encouraging prosocial behaviour, increasing charitable intention, and augmenting empathy are among these social benefits.

Social Connectedness. Nostalgia's high social value has led researchers to investigate whether it aids individuals in feeling connected to others and affects feelings of acceptance and belonging (Abakoumkin et al., 2019, 2020; Sedikides et al., 2015, 2016). Supportively, one line of research has found that nostalgia helps individuals to fulfil their need to belong by reconnecting them with their past experiences and social circle, thus overcoming the feeling of loneliness (Zhou et al., 2008). This feature of nostalgia regulates distress that derives from deficiencies in social connections (Wildschut et al., 2010), and nurtures social connectedness (i.e. a sense of acceptance and support; Wildschut et al., 2006), which entails feeling loved, protected, connected to others, trusting others, or feeling socially supported (Sedikides et al., 2015).

More specifically, Wildschut et al. (2006) demonstrated that participants who thought about a nostalgic event (vs. those who recalled an ordinary event) experienced increased perceptions of social bonds (feeling “loved” and “protected”). Additionally, Turner et al. (2013, Study 2) indicated that participants who recalled a nostalgic (vs. ordinary) interaction with a person who suffers from mental illness subsequently showed a more positive attitude toward people with mental illness. Further, Zhou et al. (2008) examined nostalgia's impact on social support. They manipulated nostalgia and assessed perceived social support. The results revealed that those who were assigned to the nostalgia condition (vs. control) had higher perceptions of social support.

Attachment Security. Researchers have also explored the ability of nostalgia to lessen attachment anxiety and attachment avoidance, hence evoking attachment security, which is the anticipation that close others would provide support in times of need. Wildschut et al. (2006, Study 6) tested this with an ERT experiment by manipulating nostalgia and evaluating attachment anxiety and attachment avoidance via the Revised Experiences in Close Relationships Scale (Fraley, Waller & Brennan, 2000). This study demonstrated that participants in the nostalgia condition (compared to the control condition) scored lower levels of attachment anxiety and attachment avoidance. Thus, nostalgia is more likely to provide a more secure attachment style.

Individuals characterised by low levels of attachment-related avoidance, in contrast to those with high levels, depend on social bonds to manage distress. Later on, Wildschut et al. (2010) investigated that nostalgia serves as a resource for fostering such social connectedness. Low-avoidance individuals were found to extract greater social connectedness from nostalgia in comparison to those high in avoidance. The positive impact of nostalgia was notably more pronounced when attachment-related avoidance levels were low, as opposed to high. Along the same lines, Juhl et al. (2012) investigated the potential interaction between attachment-related avoidance and nostalgia to predict participants' disposition towards romantic involvements. They assessed this by measuring attachment-related avoidance and anxiety, manipulating nostalgia using the ERT, and instructing participants to state their "relationship satisfaction" and "desire to pursue a romantic relationship.". The findings indicated that in the nostalgia condition, there was a negative correlation between attachment-related avoidance and greater levels of both relationship satisfaction and relationship desire, while no such relationship was observed in the control condition.

Prosocial Behaviour. As mentioned, nostalgia bolsters social connectedness and attachment security. Considering this, researchers have speculated that nostalgic recollections can serve further benefits by providing a heightened awareness of social issues, hence encouraging people to engage in prosocial behaviour such as increased helping, charitable intentions and behaviour, and monetary donations.

To investigate this, Stephan et al. (2014, Study 5) designed an experiment where participants first underwent an ERT induction (Sedikides et al., 2015) and were exposed to a deliberate mishap to provide an opportunity for offering help. In more detail, an experimenter, who was unaware of the experimental condition to which each of the participants had been allocated, entered the room carrying a box of pencils, then 'by mistake' spilt the pencils in front of the participants. Following this, the researchers measured helpfulness by counting the number of pencils that were picked up by the participants. The results revealed that those participants who were assigned to the nostalgia condition (compared to the control) helped the experimenter more by picking up a higher amount of pencils. Following this, Juhl et al. (2021, Experiment 1) examined the role of nostalgia on help-seeking, based on the literature that demonstrated how individuals frequently lack the motivation to look for assistance (Bohns & Flynn, 2010). They manipulated nostalgia experimentally through the ERT (Sedikides et al., 2015), and assessed help-seeking with four statements (e.g. "With this event in mind, I feel…that I can ask for assistance when I am in trouble"). The findings revealed that nostalgia encourages people to seek help. These results were replicated in their subsequent experiment, where they assigned participants to one of the ERT conditions and measured help-seeking behaviour by instructing participants first to solve an easy problem, and then an unsolvable problem. In the event that a participant required assistance in solving the problem, they were instructed to use a button located on an intercom system to get in touch with the researcher. Results showed that participants in the nostalgia condition (vs. control) sought aid more quickly.

In another line of research, Zhou et al. (2012) aimed to discover nostalgia's impact on charitable intentions and behaviour. Across Studies 1 to 4, they experimentally induced nostalgia and then measured charitable giving with several assessments. The findings indicated that nostalgia encourages people to have charitable intentions. Another interesting finding of the study was the mediational effect of empathy on the link between nostalgia and charitable intentions. In Study 5, Zhou et al. induced nostalgia via charity appeals that either emphasised the past (nostalgia condition) or the future (control condition; for details see Zhou et al., 2012, Study 5), and assessed charitable giving. The findings demonstrated that nostalgic participants engaged in charitable behaviour and offered monetary donations more than those assigned to the control condition. In another study, Kim and Childs (2020) emphasised consumers' responses to charity messages regarding clothing donation and explored the potential impact of nostalgia on this behaviour. The results indicated that both state and trait nostalgia played a significant role in enhancing clothing donation intentions. A more recent study also examined the influence of nostalgia proneness on the willingness to make online donations (Zhang & Tao, 2022). The findings indicated that a positive relationship exists between the inclination towards nostalgia and the strength of both familial and emotional utilities. Increased levels of nostalgia intensity in donors correspond to higher levels of trust placed in charitable organizations. Additionally, the dedication of donors to their affiliations with charitable organizations plays a significant role in influencing their willingness. All in all, individuals feel more socially engaged as a result of nostalgising, and that leads to a rise in people's intention to help each other, and an increase in charitable behaviour. This may be attributed, in part, to a diminished emphasis on monetary desires. In fact, Lasaleta et al. (2014) addressed this matter through six studies, illustrating that experiencing nostalgia led to a reduction in individuals' tendency towards desiring money. The results showed that participants in the nostalgia condition tended to exhibit a higher willingness to pay for products, contribute more money, assign a lower value to money, have decreased willingness to exert effort in acquiring money, and sketch smaller coins, than those in the control condition.

1.6.4 Summary

To summarise, nostalgia has a potentially beneficial influence on psychological well-being. It provides existential (i.e. meaning in life), self-related (i.e. positive affect, self-esteem, optimism, self-continuity), and social (i.e. social connectedness, attachment security, prosocial behaviour) benefits. Recent research and meta-analysis findings suggest that the functions of nostalgia are not limited solely to the university-age cohorts commonly examined in earlier studies but extend to more vulnerable populations. These include individuals, with dementia (Ismail et al., 2020), with addiction (Wohl et al. 2018), refugees (Wildschut, Sedikides and Alowidy, 2019), and individuals with high levels of neuroticism (Frankenbach et al. 2020).

1.7 Nostalgia as a Personality Trait

Trait nostalgia (i.e. dispositional nostalgia) is characterised by a tendency to feel nostalgic frequently (Juhl et al., 2020). Studies demonstrated that trait nostalgia confers psychological well-being by raising happiness (Bryant, Smart & King, 2005; Zhou et al., 2022), increasing authenticity (Kelley et al., 2022), decreasing death-related thoughts (Routledge et al., 2008; Juhl et al., 2010), and bolstering social connections (Sedikides et al., 2006). However, there are contrasting views on the functional signature of trait nostalgia. Although individuals with a tendency towards nostalgia report greater psychological well-being (Baldwin, Biernat & Landau, 2015) and are less likely to experience existential concerns (Juhl et al., 2010), there is a positive association between dispositional nostalgia and potentially negative traits. In particular, the positive associations between nostalgia and greater sadness (Barett et al., 2010; Batcho, 2007), greater neuroticism (Seehusen et al., 2013), greater loneliness (Zhou et al., 2008), rumination, and counterfactual thinking (Cheung et al., 2018) have paved the way for opposing views in the literature. Additionally, scholars in the psychodynamic tradition argue that nostalgia-prone individuals live in the past as a result of their inability to cope with present challenges (Castelnuovo-Tedesco, 1980; Sedikides et al., 2004). Besides, in a more recent study, Newman (2022) proposed that the relation between trait nostalgia and well-being may be more negative due to demographic differences. To test this hypothesis, he assessed trait nostalgia, meaning in life, satisfaction with life, and positive and negative affect, and obtained demographics regarding household income. They used panel data that was collected at different time points. Participants completed measures related to satisfaction with life, positive affect, and negative affect between September 2014 and July 2018, and nostalgia and meaning in life between December 2019 and February 2020. The findings revealed that income was positively correlated with well-being while trait nostalgia was negatively correlated. Importantly, these correlations were moderated in such a way that the negative association between nostalgia and well-being was larger among members of low-income families than among members of high-income households. Considering this literature, while experimental research has emphasised the psychological advantages of state nostalgia, correlational research occasionally casts doubt on the adaptability of trait nostalgia. However, when these relations were examined in detail, it was discovered that trait nostalgia does not indicate or lead to unfavourable personality traits, in contrast with the maladaptive view.

Taking into consideration the desire for social approval and the fear of rejection by others, Leary et al. (2006) suggested a probable connection between Neuroticism and the essential need to belong. In the same way, Seehusen et al. (2013) also indicated that as a result of these belongingness needs, one might become susceptible to fluctuations in social acceptability and rejection, and they further demonstrated a link between trait nostalgia, need to belong, and Neuroticism. They argued that such a relation may have developed on the premise that, through nostalgia, individuals can reconnect with their former experiences and relationships and satisfy their need for belonging, and the association between dispositional nostalgia and Neuroticism may arise depending on the need to belong. Indeed, when the need to belong was controlled, the relation between Neuroticism and trait nostalgia was eliminated. Moreover, they found that a higher need to belong predicts higher trait nostalgia, above and beyond Neuroticism.

Regarding the positive association between trait nostalgia and loneliness, nostalgia has been described as a notion encompassing symbolic relationships with close others, which strengthens deep social ties (Sedikides et al., 2006), and loneliness is an internal trigger of nostalgia (Wildschut et al., 2006). Additionally, Zhou et al. (2008) stated that trait nostalgia is positively correlated with social connectedness, and loneliness indirectly contributes to stronger social support through trait nostalgia. That is, individuals use nostalgia to bolster their perception of social support. In a similar study, Abakoumkin, Wildschut and Sedikides (2020) assessed the relation between trait nostalgia and the importance of the collective self. They measured trait nostalgia with the Southampton Nostalgia Scale (SNS; Routledge et al., 2008) and Nostalgia Inventory (NI; Batcho, 1995), and they assessed horizontal collectivism (e.g. “To me, pleasure is spending time with others”), vertical collectivism (e.g. “It is important to me that I respect the decisions made by my groups”), horizontal individualism (e.g. “My personal identity, independent of others, is very important to me”), and vertical individualism (e.g. “Competition is the law of nature”). Their results indicated that relational collectivism, which places a focus on one's ties to intimate friends and small social networks, is positively connected with trait nostalgia.

To shed light on nostalgia, rumination and counterfactual thinking association, Cheung et al. (2018) assessed the resemblances and distinctions between those three different ways of thinking about the past with a correlational study. They assessed trait nostalgia, rumination, counterfactual thinking, and the functions of autobiographical memory (intimacy maintenance, teach/inform, self-regard, bitterness revival, conversation, boredom reduction, and death preparation). They pointed out that although trait nostalgia, rumination, and counterfactual thinking were positively correlated, canonical correlations revealed that trait nostalgia is strongly associated with intimacy maintenance and self-regard but not bitterness revival, which shows that, unlike rumination and counterfactual thinking, trait nostalgia has a more positive functional signature.

Lastly, regarding the relation of trait nostalgia with existential concerns, Routledge et al. (2008) assessed nostalgia's potential to protect from death-related thoughts with an experiment wherein they measured trait nostalgia and manipulated mortality salience (i.e. the activation of death thoughts). They indicated that participants who were more prone to nostalgia were less likely to think of death when mortality was salient. Additionally, although thinking about mortality resulted in lower life satisfaction, participants with a higher trait nostalgia reported greater meaning in life. In the same vein, Juhl et al. (2010) tested the buffering effect of trait nostalgia on existential threat by creating two experimental conditions with a death awareness manipulation (mortality-salience vs. control), and measuring trait nostalgia and death anxiety. The results indicated that individuals with high trait nostalgia (vs. low trait nostalgia) had lower levels of death anxiety after the mortality salience manipulation, which suggested that individuals with a tendency to feel nostalgic are relatively competent when it comes to coping with existential concerns.

1.8 Nostalgia, Empathy and Facial Emotion Categorisation

1.8.1 Empathy

Empathy is defined as "the ability to understand and share the feelings of another" (New Oxford Dictionary of English, 1998). Besides the formal dictionary entry, Batson, Fultz, and Schoenrade (1987) defined empathy as the capacity to recognise and express a range of emotional reactions (e.g. sympathetic, moved, compassionate, tender, warm, softhearted). In the literature, empathy is widely accepted to be comprised of three primary components: emotional monitoring and regulation mechanisms; cognitive ability to take on another person's perspective; and an emotional reaction to another person, which frequently involves sharing that person's emotional condition (Batson et al., 1997; Davis, 1983; Decety & Jackson, 2004; Decety & Jackson, 2006; Eisenberg, 2000; Ickes, 1997). The ability to empathise allows individuals to gain an understanding of the intentions of others, predict their behaviour, and experience the emotions that they feel, facilitating effective social interaction (Baron-Cohen & Wheelwright, 2004; Smith, 2006). In accordance with these definitions, empathy encompasses a range of phenomena, such as sympathy, emotional contagion, personal distress, and perspective-taking (Hoffman, 2001; Preston & de Waal, 2002). However, this definition does not facilitate precise assertions about the core nature of empathy, as its characterization can be argued to depend on the degree of empathy involved (Hoffman, 2002). Consequently, some scholars opt to refine the concept of empathy to differentiate it from the aforementioned phenomena. They posit that empathy is present when: (i) an individual experiences an affective state; (ii) this state mirrors another person's affective state; (iii) this state is triggered by the observation or imagination of another person's affective state; (iv) one recognizes that the other person is the origin of one's own affective state (De Vignemont & Singer, 2006; Eisenberg & Fabes, 1990; Wispé, 1986).

To consider empathy in more detail, researchers separated the affective and cognitive components of it (Davis, 1983; Elliot et al., 2011; Smith, 2006; Strayer, 1987). While cognitive empathy is defined as the capacity to comprehend the thoughts and feelings of others without being required to respond emotionally, as well as the skill of being able to portray cognitively the thought processes of other individuals (Blair, 2005; Eisenberg & Miller, 1987; Spinella, 2005), affective empathy is the capacity to experience another's emotions and thoughts indirectly, as well as a response to another person's emotional circumstances and other emotional inputs (Blair, 2005; Eisenberg & Miller, 1987; Reniers et al., 2011). However, not all studies lend support to this view; in addition to affective and cognitive empathy, some researchers have proposed the term "empathic accuracy" to describe the third component of empathy (see Ickes et al., 1990; Ickes, 1993; Ickes, 1997; Levenson & Ruef, 1992; Simpson, Ickes & Blackstone, 1995). Ickes (1993) focused on this third component and described empathic accuracy as the capacity to recognise the emotional signals being sent by another person with accuracy. In other words, he operationalised empathic accuracy as the extent to which the perceiver's inference corresponds to the target's thoughts or emotions. Zaki, Bolger, and Ochsner (2008), on the other hand, equated empathic accuracy with cognitive empathy, as it requires understanding the inner state of another person and accurately assessing their thoughts and feelings. The procedures that assess empathic accuracy examine how perceivers notice changes in the emotional state of others and the degree to which their emotional evaluations and those of others are correlated on the same occasion (Zaki et al., 2008; 2009), whereas the tasks that assess cognitive empathy focus on emotion recognition (Decety & Moriguchi, 2007; Reniers et al., 2011).

1.8.2 Empathy and Facial Emotion Categorisation

Maintaining social interactions and social functioning requires a steady stream of social information processing (Decety et al., 2014; Drimalla et al., 2019). Direct observation of one's behaviour and interaction with other people provides individuals with information supporting their self-perceptions (Aron, 2003; Slotter & Gardner, 2014; Tice & Baumeister, 2001). During social encounters, faces are often the focal point, since individuals pay close attention to faces to receive clues about the emotional state and the level of engagement, and they have a communicative role in facilitating sociality (Leopold & Rhodes, 2010; Theeuwes & Van der Stigchel, 2006). In fact, as demonstrated by Whalen et al. (2004), even minimal amounts of facial information contribute to emotion recognition. They presented fearful and happy face stimuli by removing all information from the face except the eye-whites (i.e., sclera) and presented the stimuli for 17 ms. They discovered that the eye area of the face plays a crucial role in extracting expressive information. Additionally, the data indicate that the amygdala responds to the emotions presented through "wide-eyed" expressions. Interpersonal information may be sent through facial expressions as a form of communication, allowing for the establishment and control of interpersonal interactions as well as the encouragement of bonding (Balconi & Pozzoli, 2009; Wolpert, Doya & Kawato, 2003), and this can help individuals to regulate actions by comprehending others' intentions and actions via their facial expressions (Ekman, 1992; Horstmann, 2002). Interpersonal communication and relationships are adversely impacted when people are unable to recognise and experience a typical range of emotions. In such cases, facial expressions play a crucial role in social interactions by provoking immediate responses from the observer (Decety et al., 2014; Ekman & Friesen, 1969; Scherer & Scherer, 2011).

On this basis, researchers have investigated variables that may have an impact on the ability to perceive and recognise emotions through facial expressions, and empathy has emerged as a significant factor in the comprehension of facial expressions. As previously mentioned, one of the fundamental aspects of empathy lies in the recognition of affective states. Given that faces serve as primary conduits for crucial emotional information, it is reasonable to postulate a correlation between empathy and the processing of facial emotions. More specifically, Hess and Blairy (2001) investigated whether dispositional empathy leads to better recognition of facial expressions of emotions. They presented a series of brief video clips of faces expressing anger, sadness, disgust and happiness, and they measured the emotional contagion. Results indicated that there is a significant and positive correlation between expression perception and emotional empathy. In the same vein, Andréasson and Dimberg (2008) inquired whether sensitivity to facial input is linked to emotional empathy. They administered the Questionnaire Measure of Emotional Empathy (QMEE; Mehrabian & Epstein, 1972), and, as a cover narrative, participants were told that the aim of the study was to look at participants' physiological reactions as they watched a few short videos. Then, participants were assigned randomly to one of the happy or sulky conditions. The findings revealed a significant interaction between empathy (high vs. low) and condition (happy vs. sulky), which suggests that high-empathic participants assessed the videos as funnier in the happy condition and as less funny in the sulky condition, compared to the low-empathic group.

In another study, Balconi and Bortolotti (2013) examined the relationship between face detection in response to positive and negative emotional patterns and emotional empathy. To investigate that, they presented pictures showing a happy, angry, fearful, or neutral face, instructed participants to make a two-alternative forced-choice response (emotion; no emotion), and instructed participants to empathise with the facial stimulus represented. Finally, they asked participants to complete the Balanced Emotional Empathy Scale (BEES; Mehrabian, 1996). The findings suggested that emotions across faces are differentiated more successfully by participants with higher empathy levels. Additionally, individuals who reported greater empathy were also better at recognising facial patterns than those with a low empathy level. However, Balconi and Bortolotti (2013) also noted that empathy does not necessarily facilitate emotional face recognition, especially where the frontal cortex is perturbed via Repeated Transcranial Magnetic Stimulation (rTMS). They found that participants in the high-affective empathy condition (compared to low-affective) were unable to reliably discriminate between facial signals. In other words, when the medial prefrontal cortex was suppressed by rTMS stimulation, face detection skill was decreased, and empathy was not able to reverse this decline.

To explore further whether empathy is required to perceive emotional facial expressions, Balconi and Canavesio (2016) assessed the link between emotional empathy, attentional processes, and face detection performance. They presented pictures of happy, sad, fearful, angry or natural faces in a random order (each stimulus was presented for 500 ms), and instructed participants to make a two-alternative forced-choice response (emotion; no emotion). Then, they measured empathy using BEES (Mehrabian, 1996), along with facial electromyography activity and eye movement. The results offered evidence that people with high empathic traits (as compared to those with low) recognised emotional expressions across faces more accurately, had a faster reaction time regarding detection performance, and focused on specific areas across faces (i.e. mouth and eyes).

It is worth noting that, even though the link between emotional face detection and empathy has been studied extensively and the findings frequently show strong correlations between them, research examining this relation through cognitive empathy is rare in comparison.

1.8.3 Empathy and Nostalgia

Nostalgia is a social emotion that strengthens our sense of social connection and interpersonal ties (Abeyta et al., 2015a; Hepper et al., 2012; Wildschut et al., 2006). Additionally, researchers have shown that nostalgia encourages individuals to engage in prosocial behaviour (Zhou et al., 2012), and enhances one's perception of social support (Wildschut et al., 2006; Zhou et al., 2008). Based on the evidence, the existing research has suggested an association between nostalgia (i.e. state nostalgia and trait nostalgia) and empathy.

In one study, Zhou et al. (2012, Study 2-4) investigated whether experimentally induced nostalgia augments empathy. To test that, they induced nostalgia via an event reflection task and provided participants with a one-page information sheet about an organisation (i.e. the Half the Sky Foundation), whose aim was to help earthquake victims. They then assessed the level of state empathy by instructing participants to rate their experience (i.e. sympathetic, compassionate, softhearted, tender) while reading the description provided before. The findings indicated that participants in the nostalgia group (vs. control) stated higher empathy for the victims, and confirmed that nostalgia fosters an empathic attitude towards others. In a subsequent study, they replicated the findings using a different charitable cause, and with diverse participant samples (Zhou et al., 2012).

In a correlational study, where Cheung et al. (2017, Study 3) measured trait nostalgia and empathy by using the Southampton Nostalgia Scale (SNS; Routledge, Arndt, Sedikides & Wildschut, 2008) and six empathy-related adjectives (empathetic, tender, concerned for others, sympathetic, compassionate, soft-hearted) (Batson et al., 1983; Batson, Fultz & Schoenrade, 1987; Coke, Batson & McDavis, 1978), the researchers found a significant and positive association between trait nostalgia and empathy.

In a more recent study, Juhl et al. (2020) hypothesised that as trait nostalgia increases individuals become more empathetic, and they evaluated that relation. In Study 1, they assessed the relation between trait nostalgia and affective empathy. They administrated SNS (Routledge et al., 2008) and Nostalgia Inventory (NI; Batcho, 1998) to measure trait nostalgia (i.e. the proneness, frequency, and personal relevance of nostalgia), and Affective Empathy Scale (Mehrabian & Epstein, 1972) to measure affective empathy. The results revealed a significant and positive correlation between trait nostalgia and affective empathy. In Study 3, they aimed to replicate the previous findings and they also assessed the relation between trait nostalgia and cognitive empathy. To test that, they instructed participants to complete SNS and NI, to measure trait nostalgia, and a Basic

Empathy Scale (BES; Jolliffe & Farrington, 2006), to measure cognitive and affective empathy. Consistent with the previous findings, they found a significant and positive association between trait nostalgia and affective empathy. However, compared to cognitive empathy, trait nostalgia was more strongly associated with affective empathy.

In another study, Newman et al. (2020) measured trait nostalgia via the Personal Inventory of Nostalgic Experiences (PINE; Newman et al., 2020), and empathy via the Interpersonal Reactivity Index (IRI; Davis, 1983). The results showed that trait nostalgia was positively related to empathy.

Taken together, although these results must be interpreted with caution due to the correlational designs preventing causal inferences, the findings provided evidence that nostalgia increases empathy, and there is a relation between trait nostalgia and empathy.

1.8.4 Summary

In this section, I have described the literature that led me to establish the hypothesis that I will present in Chapter 2, which is that trait nostalgia will be related to enhanced facial emotion categorisation by virtue of its relation to higher empathy. That is, empathy will mediate the relation between trait nostalgia and enhanced sensitivity to facial stimuli.

1.9 The Present Thesis

I have reviewed the existing literature and laid the groundwork for the studies described in the upcoming chapters. In this thesis, I have sought to address important gaps in the literature and contribute to it by assessing nostalgia from three distinct viewpoints through three empirical studies. First, I have investigated whether nostalgia could lead to changes in facial emotion categorisation via empathy. Second, I have explored the efficacy of VR technology as a novel method for nostalgia induction. Third, I have expanded the understanding of the efficacy of VR in inducing nostalgia, and explored how the duration of nostalgic feelings changes when elicited using VR or ERT; that is, I have compared the two nostalgia induction methods in terms of their effects on felt nostalgia and psychological benefits over time.

1.9.1 Nostalgia, Empathy, Attachment and Facial Emotion Categorisation (Chapter 2)

Previous research has demonstrated a link between nostalgia and increased empathy (Cheung et al., 2017; Juhl et al., 2020; Newman et al., 2020; Zhou et al., 2012). Studies have also suggested that empathy is a possible facilitator of emotional face categorisation (Andréasson & Dimberg, 2008; Balconi & Bortolotti, 2013; Balconi & Canavesio, 2016; Hess & Blairy, 2001). In Chapter 2, I extend these findings by investigating whether nostalgia makes the cues across faces meaningful through empathy, via two studies. In Experiment 1, I examine the relation between trait nostalgia, cognitive empathy, affective empathy, and facial emotion categorisation. In Experiment 2, I focus on trait nostalgia, and I have created a novel face rating task which measures the three facets of empathy (i.e. cognitive empathy, affective empathy, and empathic accuracy).

1.9.2 Nostalgia Induction via Virtual Reality (Chapter 3)

To induce a nostalgic state in people experimentally, researchers have used techniques various techniques, including the Event Reflection Task (Sedikides et al., 2015), music (Barrett et al., 2010; Cheung et al., 2013; Evans et al., 2022; Stephan et al., 2015; Zhou et al., 2012), song lyrics (Cheung et al., 2013), scents (Reid et al., 2015), food (Reid et al., 2022), and a visual imagery task (Verplanken, 2012). I have sought a novel method that may provide a more efficient means of experimental nostalgia induction, and for this, I have proposed VR. In Chapter 3, I will aim to determine whether VR could emerge as an effective nostalgia elicitation method, and whether using VR technology could provide a more immersive and intense nostalgic experience.

1.9.3 The Duration of Nostalgia (Chapter 4)

Researchers have demonstrated the crucial psychological benefits that are served by nostalgia (i.e. existential, self-related, social). Although nostalgia has been investigated in detail, no research has explored how long these benefits and nostalgic feelings are felt by individuals. In Chapter 4, I present a preliminary investigation and two experiments, the intention of which is to explore the temporal changes in the intensity of momentary nostalgia and its benefits. In Experiment 1, nostalgia was induced using the Event Reflection Task (ERT; Sedikides et al., 2015), and the level of nostalgia and psychological benefits were measured at five-time points throughout the experiment. In Experiment 2, the design was extended with another nostalgia manipulation method using VR in addition to ERT. I compared the two induction techniques regarding their effectiveness in lengthening in-the-moment nostalgia and its benefits.

Chapter 2

Empirical Paper I

Nostalgia and Facial Emotion Categorisation

For Chapter 2, I was motivated by the existing studies that highlight the connection between nostalgia, empathy, and attachment security, and suggest a relationship between empathy and the ability to recognise facial emotions. To build upon these insights, I have conducted two studies aimed at exploring whether nostalgia contributes to the categorisation of facial emotional cues, particularly through the mechanisms of empathy or attachment security. I sought to extend our understanding of how nostalgia may influence the interpretation of emotional facial expressions and deepen our insights into the intricate correlations among these variables.

Chapter 2

Does Nostalgia Make Facial Information More Meaningful: The Relation Between Nostalgia, Empathy, Attachment and Facial Emotion Categorisation

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Abstract

Nostalgia is a sentimental longing for one's past, and it is a fundamentally positive feeling, which includes personal experiences and social bonds. Previous research has shown that nostalgia is related to greater empathy, and, separately, that empathy is a potential enabler of emotional face categorisation by promoting the recognition of emotional cues in facial expressions. In the present study, the hypothesis is that nostalgia, by virtue of its link with empathy, is associated with emotional face processing. In Experiment 1, we tested the impact of experimentally induced nostalgia on emotional face categorisation, and examined the relation between nostalgia proneness, empathy, and face processing. Participants first completed trait measures of nostalgia proneness. After recalling either a nostalgic or ordinary memory, they performed an emotional face categorisation task, followed by measures of empathy. The results were partly supportive. Participants in the nostalgia and control conditions did not differ in terms of their ability to detect changes in the intensity of targets' emotional expressions, and the precision of their estimates. Nostalgia proneness, on the other hand, was related to the detection of changes in intensity and the precision of the estimates. This association between nostalgia proneness and the certainty of perceived emotion detection was mediated by empathy. In Experiment 2, we further examined mediators of the relation between nostalgia proneness and emotional face processing, including affective, cognitive, trait empathy and attachment security. Although we found significant relationships separately, our results indicate that neither empathy nor attachment security mediated the relationship between nostalgia proneness and emotional face categorisation.

Keywords: nostalgia, cognitive empathy, affective empathy, emotional face categorisation

Does Nostalgia Make Facial Information More Meaningful: The Relation Between Nostalgia, Empathy, Attachment and Facial Emotion Categorisation

Nostalgia, defined as ‘a sentimental longing or a wistful affection for the past’ (New Oxford Dictionary of English, 1998), is an emotion that has a highly social characteristic (Sedikides et al., 2015). While nostalgia often revolves around the self as a key figure, and centres on an individual's personal experiences and memories, it is almost always laid within a social framework (Sedikides & Wildschut, 2020; Van Tilburg et al., 2018; Zou et al., 2018). Consequently, a nostalgically remembered memory creates indirect social bonds with one's social surroundings, as the content is generally centred around significant others (e.g. family members, friends, and partners) (Abeyta et al., 2015a; Holak & Havlena, 1992; Wildschut et al., 2006). There is also evidence of the relationship between attachment security, empathy toward others, and social connections bolstered by nostalgia (Abeyta et al., 2015b; Wildschut et al., 2006; Zhou et al., 2012). Considering these relationships, we sought to expand the literature by exploring how nostalgia may influence the interpretation of emotional facial expressions and deepen our insights into the overall correlations among nostalgia empathy, attachment security, and emotional face categorisation in two studies.

Nostalgia

Nostalgia is an emotion that involves a longing for the past, and is often accompanied by positive feelings (Wildschut et al., 2006). It encompasses recollections not only of one's personally meaningful experiences but also those involving close relationships and broader social connections (Holak & Havlena, 1998; Sedikides et al., 2008). Narrative analyses have revealed that nostalgic memories often include significant others in an individual’s life, such as family members and friends (Batcho, 1998; Holak & Havlena, 1992), special events e.g. graduation ceremonies, anniversaries, holidays, and birthdays (Wildschut et al., 2006), and certain periods of life such as childhood, youth, and college years (Batcho, 1995).

The physician Johannes Hofer (1688/1934) introduced the term nostalgia to allude to a medical disease displayed by Swiss mercenaries who fought in faraway countries. Then, over the years, the meaning of nostalgia has altered from its initial negative connotations as a medical disease (Hofer, 1688/1934; McCann, 1941), a psychiatric or psychosomatic disorder (Havlena & Holak, 1991), and homesickness (Rosen, 1975; Sedikides et al., 2004), to positive associations including warm memories, the ‘good old days’ (Davis, 1979), and joy (Kaplan, 1987). In the current literature, nostalgia has been accepted as a bitter-sweet and mixed (Batcho, 2013; Frijda, 2007; Wildschut et al., 2006) but predominantly positive (Hepper et al., 2012; Zhou et al., 2012), past-oriented (Seehusen et al., 2013), and self-relevant (Cheung et al., 2018; Stephan et al., 2014) emotion. Although nostalgia is also linked to negative emotions, especially with the yearning for an irretrievable past and the associated sadness (Hepper et al., 2012; Holbrook, 1993; Wildschut, Sedikides & Alowidy, 2019), individuals tend to remember nostalgic memories with 'rose-coloured glasses’, as nostalgia involves meaningful and fond memories in particular (Hepper et al., 2012). Moreover, people experience happiness, affection, and tenderness as a result of nostalgising, even if the nostalgic memory involves the loss of a beloved person (Lasaleta, Sedikides & Vohs, 2014).

Nostalgia is a frequent experience, and almost everyone in every age cohort and culture will ‘feel nostalgic’ across their lifespan (Batcho, 2013; Boym, 2001). For instance, 79% of undergraduates surveyed indicated that they feel nostalgic at least once a week or more (Wildschut et al., 2006). It has been found that certain subjective (e.g. negative affect, social exclusion, loneliness, meaninglessness, the discontinuity between one’s past and one’s present, and boredom) and environmental triggers (e.g. one’s hometown-related objects, possessions, smells, taste-oriented associations, music) play a role in the emergence of felt nostalgia (Wildschut et al., 2006; Wildschut & Sedikides, 2022), which confers essential psychological and social functions for individuals. Researchers have studied nostalgia at state and trait levels to examine those functions of nostalgia and their effects on the personality structure.

Momentary Nostalgia (State Nostalgia)

Momentary nostalgia (state nostalgia) is a transient experience that may occur in daily life when triggered by external or internal stimuli, as mentioned above (Wildschut et al., 2006). To elicit nostalgic experiences in laboratory settings and to further investigate the psychological health benefits of momentary nostalgia, researchers have developed several validated experimental tasks, such as the Event Reflection Task (ERT) (Sedikides et al., 2015), visual imagery tasks (Verplanken, 2012), and tasks involving music or song lyrics (Cheung et al., 2013). Of all these techniques, ERT is usually a widely used method to induce nostalgia and create experimental conditions (i.e. nostalgic vs control groups). The instructions ask participants to retrieve either a nostalgic or an ordinary event from their past (Sedikides et al., 2015; Wildschut et al., 2006; Wildschut & Sedikides, 2020). Studies in experimental settings have revealed several vital functions of momentary nostalgia (Routledge et al., 2011; Wildschut et al., 2006). These functions contributed to psychological well-being, and explained the connection of nostalgia with many other concepts.

Functions of Nostalgia

Experimental studies established empirical evidence that nostalgia promotes a variety of crucial self-related, existential, and social functions (Wildschut & Sedikides, 2020; Wildschut & Sedikides, 2022). To begin with the self-oriented functions, nostalgia increases positive affect (Wildschut et al., 2006), and self-esteem (Sedikides & Alicke, 2012; Vess et al., 2012), by helping to preserve a positive perception of oneself.

Additionally, it facilitates a sense of self-continuity by allowing a connection to be made between past and present selves (Sedikides et al., 2008; Sedikides et al., 2015).

Nostalgic recollections (compared to ordinary) also serve as a resource for coping with existential challenges via fortifying a sense of meaning in life (Routledge et al., 2011; Sedikides & Wildschut, 2018). As nostalgia confers a favourable perception of past experiences, potentially leads to a more meaningful life.

Lastly, nostalgia has a sociality function. Nostalgia strengthens social connectedness (Wildschut et al., 2010; Zhou et al., 2008), encourages prosocial behaviour (Zhou et al., 2012), and decreases attachment anxiety and attachment avoidance (Wildschut et al., 2006, Study 6). Nostalgic recollections often centre on one's social interactions, suggesting that nostalgia contributes to the formation and maintenance of social relationships, and enhances perceptions of social support (Sedikides et al., 2015; Wildschut et al., 2006; Wildschut et al., 2010). Moreover, nostalgia elicits a sense of attachment security, which entails the expectation that significant others will offer assistance during times of distress (Wildschut et al., 2006).

Nostalgia Proneness (Trait Nostalgia)

Nostalgia proneness (trait nostalgia) is the dispositional tendency to experience nostalgia regularly. Individuals with a tendency toward nostalgia also may be expected to benefit from its positive functions. Yet, the current literature offers contradictory findings on the benefits of nostalgia proneness. Given that nostalgia proneness is associated with greater sadness (Barett et al., 2010; Batcho, 2007), greater loneliness (Zhou et al., 2008), and neuroticism (Seehusen et al., 2013), one can consider that nostalgia has a maladaptive nature. Additionally, psychodynamic theorists have advocated the view that nostalgia-prone individuals live in the past because they are unable to cope with present challenges (Castelnuovo-Tedesco, 1980).

However, upon closer examination of these relationships, it has been found that trait nostalgia does not signify or cause unfavourable personality traits, contrary to the maladaptive perspective. Nostalgia has been seen as a concept involving symbolic connections with significant others, which bolsters meaningful social bonds (Sedikides et al., 2006). Loneliness, on the other hand, has been found to be a trigger of nostalgia (Wildschut et al., 2006, Study 4). Additionally, Zhou et al. (2008) stated that the indirect effect of loneliness on perceived social support via nostalgia proneness was significant, which suggests that lonely individuals use nostalgia to bolster feelings of social support.

Further, Leary et al. (2006) suggested a possible link between neuroticism and the fundamental need to belong, based on the desire for social acceptance and the reluctance towards being rejected by others. This association was demonstrated by Seehusen et al. (2013), who found that individuals with a high need to belong scored higher on neuroticism. In addition, the study also showed that the need to belong was positively associated with nostalgia proneness. Such a relationship may have arisen on the basis that individuals can reconnect to their past experiences and relationships through nostalgia, and meet their need for belonging. When the need to belong was controlled (partialled out), the relation between neuroticism and nostalgia proneness was no longer significant (Seehusen et al., 2013, Study 2). Furthermore, the need to belong predicted higher nostalgia proneness, above and beyond neuroticism.

There is also a critical role of nostalgia proneness in relation to existential concerns and psychological well-being. Regarding existential threat, Juhl et al. (2010) created two groups with a death awareness manipulation (mortality salience vs. pain control condition), and measured nostalgia proneness and death anxiety. In terms of mortality salience, death anxiety increased for those low, but not high, in nostalgia proneness. Thus, individuals predisposed to feeling nostalgic are relatively competent in dealing with existential concerns (Juhl et al., 2010). Further, individuals with higher levels of nostalgia proneness showed enhanced psychological well-being (Baldwin, Biernat & Landau, 2015). Given that trait nostalgia leads to increased nostalgic reverie, it might lead to greater utilisation of nostalgia's psychological functions, such as enhanced meaning in life, better social connectedness, and increased self-esteem (Routledge et al., 2012; Routledge et al., 2013).

Empathy

The New Oxford Dictionary of English (1998, p. 604) defines empathy as "the ability to understand and share the feelings of another". Batson et al. (1987) characterised empathy as the ability to perceive and express several emotional responses (e.g. sympathetic, moved, compassionate, tender, warm, softhearted). Empathy allows individuals to maintain interaction with their social surroundings, comprehend the intentions of others, and anticipate their actions (Baron-Cohen & Wheelwright, 2004). Previous research has established the three constitutive elements of empathy: (1) an emotional congruence to another person (which could entail experiencing that emotional condition); (2) a cognitive capability to perceive other individuals' perspectives; and (3) some monitoring and regulatory mechanisms which keep track of the origins of self and other's sensations (Balconi & Bortolotti, 2013; Decety & Jackson, 2004; Eisenberg, 2000). A more precise conceptualisation posits the presence of empathy when; (1) an individual experiences an affective state, (2) this state bears an isomorphic resemblance to the affective state of another person, (3) the origination of this state is prompted by the observation or imaginative contemplation of another person's affective state, and (4) there exists an awareness that the other person is the source of one's own affective state (De Vignemont & Singer, 2006; Eisenberg & Fabes, 1990; Wispé, 1986). Empathy often contains cognitive and affective components (Davis, 1983; Elliott et al., 2011; Smith, 2006). Whereas cognitive empathy is a capacity to understand another's internal state (i.e. emotional experiences and thoughts), affective empathy refers to the ability to experience another's feelings and thoughts vicariously (Davis, 1983; Davis, 1994; Reniers et al., 2011). However, some researchers have argued that empathy must be distinguished into three components (Goldstein & Michaels, 1985; Ickes, 1993, 1997). Those scholars have used a third term, "empathic accuracy", to refer to the ability to successfully "read the mind" of others, detect emotional information, infer changes in the target's emotional state, and accurately judge the thoughts of others (Ickes, 1997; Ickes et al., 2000; Klein & Hodges, 2001; Levenson & Ruef, 1992). Since empathic accuracy is considered an ability to be able to understand one's internal state and assess thoughts and feelings (Zaki et al., 2008), a consensus has not emerged among researchers who think that this is synonymous with cognitive empathy. The disagreement among researchers is regarding whether empathic accuracy is synonymous with cognitive empathy. However, research conducted on the measurement of the aforementioned two concepts has brought to light their dissimilarity. The tasks that measure empathic accuracy assess how perceivers detect changes in the emotional state of others, and how associated the perceiver's and other's emotional ratings are on the same occasion (Ickes, 2001; Zaki et al., 2009), while measurements that assess cognitive empathy focus on emotion recognition (Decety & Moriguchi, 2007).

The Nostalgia and Empathy Link

Existing research has revealed the relation between nostalgia (for both state nostalgia and trait nostalgia) and empathy. However, the majority of investigations examining this relation (Cheung et al., 2017; Juhl et al., 2020; Newman et al., 2020; Zhou et al., 2012) have primarily focused on affective or state empathy, rather than cognitive empathy. As stated in the previous sections, one of the key features of momentary nostalgia is its social feature. Nostalgic narratives frequently feature memorable moments that are rooted in social interactions with family, friends, and/or partners (Abeyta et al., 2015a; Sedikides et al., 2016). These social interactions have been shown to indirectly fortify social bonds, bolster the relationship between the self and the social surroundings, heighten perceptions of related social support (Sedikides et al., 2008; Zhou et al., 2008), and foster a sense of social connectedness (i.e. an awareness of acceptance and support) (Wildschut et al., 2006; Wildschut et al., 2010). This function of nostalgia has been considered vital as the increase in social connectedness can enhance sensitivity to social matters, motivate individuals to participate in prosocial actions, intensify charitable intentions, and amplify empathetic responses, but not personal distress (Sedikides et al., 2015; Zhou et al., 2012). In addition, depending on nostalgia's sociability function, it has the potential to reduce attachment anxiety and attachment avoidance, thus evincing attachment security (Sedikides et al., 2008; Wildschut et al., 2006), which in turn augments empathy (Zhou et al., 2012).

The motivation of individuals to engage in social groups and foster lasting social connections throughout their lives (Mann, 1980) was complemented by their innate tendency to establish intimate and meaningful relationships with others (Baumeister & Leary, 1995). This prompted a further inquiry into whether attachment theory, which expounds on an individual's reactions to others' needs (Bowlby, 1969/1973), is a crucial factor in the development of empathic behaviour. Having avoidant or anxious attachments makes it difficult to view others as sources of security and support, or as suffering human beings whose needs should be met (Bartholomew & Horowitz, 1991; Mikulincer et al., 2001; Mikulincer et al., 2005). However, secure attachment, which refers to the need for attachment being met (for extensive details see Brennan et al., 1998; Mikulincer & Shaver, 2003), and the caregiving system, which refers to a system that ensures that the needs of others are noticed and allows empathic behaviour (Gillath et al., 2005; Mikulincer & Shaver, 2017) play an important role in relation to empathic concern (Bowlby, 1969/1982; Mikulincer et al., 2001, 2005). According to the theoretical framework, the optimal functioning of the caregiving system requires a sufficient level of attachment security (Bowlby, 1969). In other words, individuals must feel that their own attachment needs are adequately met to empathetically attend to the needs of others. Consistent with this theory, higher levels of trait attachment security, characterised by low attachment avoidance and low attachment anxiety, are correlated with increased empathy, and experimental manipulation of attachment security has been shown to enhance empathic responses (Mikulincer et al., 2001). Considering that transient experiences of nostalgia contribute to heightened attachment security (Wildschut et al., 2006) and increased empathy (Zhou et al., 2012), it can be inferred that individuals with a propensity for nostalgia may exhibit greater attachment security and, consequently, demonstrate heightened levels of empathy. Given the relevant literature, it can be concluded that momentary nostalgia serves as a basis for fostering empathic intentions and behaviours by promoting social connectedness and secure attachment (Zhou et al., 2012).

Researchers also investigated the link between trait nostalgia and empathy, and assessed the underlying theoretical premises. In a correlational study, Cheung et al. (2017; Study 3) investigated the association between dispositional nostalgia (via Southampton Nostalgia Scale; Barrett et al., 2010; Routledge et al., 2008) and state empathy with six empathy-related adjectives (empathetic, tender, concerned for others, sympathetic, compassionate, soft-hearted) (Batson et al., 1983; Batson et al., 1987). The results demonstrated a significant and positive correlation between those variables. More recently, Juhl et al. (2020) evaluated the relationship between nostalgia proneness and empathy (both cognitive and affective components of empathy) in five studies with three measures of empathy. First, they assessed the initial link between nostalgia proneness (SNS and Nostalgia Inventory; NI; Batcho, 1998) and affective empathy (Affective Empathy Scale; Mehrabian & Epstein, 1972). The results suggested a significant and positive association. Next, they focused on the population of young children. They measured trait nostalgia with SNS-C (i.e. a scale that is adapted to measure nostalgia proneness in children) and affective empathy with the Index of Empathy for Children and Adolescents (Bryant, 1982). The analysis produced similar results: that is, nostalgia-prone children reported greater affective empathy. In a subsequent experiment, they considered both affective and cognitive components of empathy. They administered SNS and NI as before to measure trait nostalgia, and used a Basic Empathy Scale (BES; Jolliffe & Farrington, 2006) to assess affective and cognitive empathy. The results suggested that nostalgia proneness and affective empathy are significantly and positively associated with each other; however, there was no significant relation between trait nostalgia and cognitive empathy. They also examined the underlying reason for the association and, based on the literature, assessed the mediating factor of attachment security with the Attachment Style Questionnaire (ASQ; Hofstra, van Oudenhoven & Buunk, 2005). Overall, the results showed that nostalgia-prone individuals expressed greater affective empathy rather than cognitive empathy, regardless of the measure, and this association was mediated by attachment security.

The Empathy and Facial Emotion Categorisation Link

Processing social information is crucial to maintaining interpersonal interaction and social functioning (Decety et al., 2014; Drimalla et al., 2019). The direct interpretation and processing of emotional cues exhibited through facial expressions represent a prominent way of comprehending an individual's affective state and underlying motivations. Facial expressions project important signals regarding feelings, and individuals primarily pay attention to people's faces (Balconi & Pozzoli, 2009; Wolpert, Doya & Kawato, 2003). Anger, fear, and happiness are among the basic emotions, which can be elicited rapidly and produce emotion-specific facial expressions (Ekman, 1992). According to the basic emotion theory, it is assumed that emotional stimuli are perceived and organised categorically, and this is an innate ability that can be found universally in each individual (Brosch, Pourtois & Sander, 2010; Ekman, 1992). Interpersonal communication and involvement could be interrupted by failing to perceive and experience a normal range of emotions (Decety et al., 2014). Therefore, the ability to perceive facial reactions is a vital part of non-verbal communication (Ekman & Friesen, 1969). Balconi and Pozzoli (2009) investigated the emotional mechanisms involved in perceiving emotional faces, by examining the changes in frequency bands (delta, theta, alpha-1 and alpha-2, and gamma) that occurred in response to the emotional face within different time intervals following the stimulus presentation. More specifically, theta oscillations correlated with the regulation of emotions, delta responses were connected to processes of signal detection and decision-making, the alpha frequency was related to warning stimuli, and gamma frequencies exhibited sensitivity to distinguishing between emotional and non-emotional stimuli. They presented images of emotional faces (happy, sad, fearful or neutral faces) with varying levels of arousal while recording the brain activity using electroencephalography (EEG). The results revealed that different frequency bands were modulated by arousal at different time intervals. The EEG results also indicated that the motivational relevance of a face has the ability to influence specific frequency bands, particularly theta and gamma. Additionally, the gamma frequency band was observed to be responsive to the level of arousal conveyed by the facial expression, whether high or low. In other words, the findings indicated a sensitivity to the subjective significance of faces in terms of their ability to elicit strong emotional responses, encompassing both high arousal and negative valence with the emotional stimuli. Furthermore, Whalen et al. (2004) showed that recognising emotions involves even the slightest facial cues. By eliminating all facial details except the eye whites, they exposed participants to fearful and happy face stimuli for a brief duration of 17 milliseconds. Their findings revealed the essential role of the eye region in extracting expressive information. Furthermore, the data suggested that the amygdala responds specifically to emotions conveyed through "wide-eyed" expressions.

Based on the relevant literature, researchers have demonstrated that a preliminary phase for an empathic response involves an accurate categorisation of emotional facial expressions (Besel & Yuille, 2010; Enticott et al., 2008). This aligns particularly with the second and third criteria, as elucidated by De Vignemont and Singer (2006), where one's affective state is isomorphic to another person’s affective state, and an individual's affective state is elicited by the observation or imagination of another person's affective state. Hofelich and Preston (2012) examined and compared how individuals with varying degrees of empathy process and encode facial emotions and employ selective attention. They asked participants to complete an Emotional Stroop Task (Preston & Stansfield, 2008) where they spontaneously encode background facial expressions (happy, sad, angry or neutral faces). Then they completed three trait empathy measures. The outcomes indicate that the attention to emotional information is enhanced by trait empathy, while the conceptual encoding takes place as an automatic result of attended perception in all individuals.

Along the same lines, empathy is also a significant factor in the comprehension of facial expressions. Previous research has established a robust association between the ability to recognise facial expressions and emotional empathy (Andréasson & Dimberg, 2008; Balconi et al., 2011; Balconi & Canavesio, 2016a; Besel, 2007). Balconi and Canavesio (2016b) examined how empathy affects the processing of emotional facial expressions, by presenting a set of pictures which included either a happy, angry, fearful or neutral face, and instructed participants to empathise with the observed emotion from the facial stimulus, and then measured emotional empathy using the Balanced Emotional Empathy Scale (BEES, Mehrabian, 1996). The results revealed that participants with higher BEES scores were more sensitive to emotional facial expressions, indicating that emotional empathy influences emotional face processing. Similarly, Balconi and Canavesio (2016a) assessed the relationship between emotional empathy, attentional mechanisms, and face detection performance. They found that people who have high empathic traits (compared to low) were more skilful in recognising emotional expressions across faces, had a faster reaction time for the detection performance, and focused on specific areas across faces (e.g. mouth and eyes), indicating that they spent more time exploring different areas across faces to comprehend the right emotion.

However, as found by Balconi and Bortolotti (2013), empathy is not always an enabler of emotional face recognition. When the frontal brain (the dorsal part of the medial frontal gyrus) is perturbed via Repeated Transcranial Magnetic Stimulation (rTMS), participants in the high-affective empathy condition (vs. low-affective empathy) were unable to distinguish facial cues accurately. In other words, when the medial prefrontal cortex was inhibited by rTMS stimulation, an impaired face detection performance was exhibited, and it was seen that empathy did not eliminate this deterioration.

Although the relationship between emotional face detection and empathy has been examined in many studies and the results have often revealed significant associations between them, it has been found that in some cases empathy is not a provider for face categorisation. In addition, this relationship has generally been evaluated through emotional empathy, and studies focusing on its relationship with cognitive empathy are sparse. However, neural mechanisms are a major contributor to the face detection-empathy link (Balconi & Canavesio, 2016a; Saarela et al., 2007). When considering the four components of empathy, criterion four 'one knows that the other person is the source of one’s own affective state' is likely to contribute to the correlation between face categorisation and cognitive empathy. Given that cognitive empathy requires a cognitive capacity to understand the thoughts and feelings of others, we investigated the relationship between face categorisation and cognitive empathy (along with affective empathy), and the contribution of nostalgia to these overall relations.

In sum, we asked, "Can nostalgia, by virtue of its link with empathy and attachment security, have an impact on facial emotion categorisation?” We sought an answer to this question through two experimental studies.

Overview

Given that nostalgia has been associated with empathy (via attachment security) (Juhl et al., 2020), and higher scores on empathy measures are associated with improved emotional face-processing abilities (Andréasson & Dimberg, 2008; Balconi et al., 2011; Balconi & Canavesio, 2016a), we expected that nostalgia would be related to more accurate emotional face categorisation skills and lower perceptual thresholds for emotional stimuli, through empathy and attachment security. No study has examined the relationship between nostalgia, empathy, and emotional face categorisation. The main objective is to explore the overall connection between nostalgia, empathy, and emotional face processing, and to find the potential mediating influence of empathy and attachment security in the proposed nostalgia-emotional face processing link.

We conducted two sexperiments to test the following hypotheses: H1. Nostalgia will be positively related to both cognitive and affective empathy, with a stronger association observed with affective empathy based on the literature (Juhl et al., 2020; Newman et al., 2020). H2. Empathy will be positively related to facial emotion categorisation (Andréasson & Dimberg, 2008; Balconi & Canavasio, 2014). H3. Nostalgia will be positively related to facial emotion categorisation. H4. The relation between nostalgia and facial emotion categorisation will be mediated by empathy and attachment security. In Experiment 1, we conceived emotional face categorisation as emotion recognition and categorisation, in a task where participants were shown two face images expressing different emotions (angry, fearful, or happy) with one face always showing a neutral expression, and were asked to choose the face that expressed the emotion more intensely. We investigated whether state and trait nostalgia could directly lead to enhanced emotional face categorisation, mediated by cognitive, affective, and state empathy. We hypothesised that nostalgia (state and trait) would have an influence on face categorisation via both cognitive, affective, and state empathy, such that the participants would be sensitive to small changes in facial emotion. In Experiment 2, we focused on nostalgia proneness and we conceived emotional face perception as both emotion categorisation and an examination of the three components of empathy (i.e. cognitive empathy, affective empathy, and empathic accuracy), through a novel face rating task. We tested our results for replicability, and examined the potential of attachment security as an additional mediator of the nostalgia-emotional face processing link.

Experiment 1

The purpose of Experiment 1 was to determine whether manipulated nostalgia (state) and nostalgia proneness (trait) could increase empathy, and evaluate whether an increase in empathy could lead to changes in participants' emotional face categorisation abilities. We assessed trait empathy (with cognitive and affective aspects) and state empathy in this study. The aim is to address (a) the difference between the experimental conditions of an ERT (i.e. nostalgia vs control conditions) for empathy; (b) the difference between the nostalgia and control conditions in the discrimination of emotional faces; and (c) the relation between nostalgia, measured empathy, and emotional face categorisation. To achieve this, we induced nostalgia experimentally using the ERT (Sedikides et al., 2015), whereby participants were instructed to recall a nostalgic (vs. ordinary) event that happened in the past, measured nostalgia proneness, measured empathy, and used an emotional face discrimination task.

Method

Participants

To determine the sample size to test the study hypotheses, we conducted an a priori power analysis using G*Power 3.1 (Faul et al., 2007). Results indicated the required sample size to achieve 80% power for detecting a medium effect size, f ~ .25, at a significance criterion of $\alpha = .05$, was 82 participants. In total, one hundred and forty-two students and staff from the University of Southampton (60 men, 82 women) completed the experiment in a laboratory setting. They ranged in age from 20 to 53 years ($M_{\text{age}} = 24.91$ years, $SD_{\text{age}} = 4.50$). Participants were recruited using an opportunity sampling technique through an online advertisement. Participation was mainly voluntary; however, participants who were students in the Psychology department received 12 research credits for participating in the study. Participants gave informed online consent before participating in the study. The data of four participants were deleted due to a technical issue; therefore, all subsequent statistical analyses are based on the results from the remaining one hundred and thirty-eight participants. The experimental protocol was approved by the Ethics Committee of the University of Southampton (Reference: 31640.A1).

Materials and Procedure

Event Reflection Task (ERT)

ERT is a validated method for inducing nostalgia in a wide variety of cohorts (Sedikides et al., 2015), and it consists of a written task. It contains instructions that encourage participants to recall either a nostalgic or an ordinary experience from their past. In the nostalgic condition, participants received a task that included the definition of nostalgia (“According to the New Oxford Dictionary of English, nostalgia is defined as a sentimental longing for the past”), and instructions that led them to think about a nostalgic event from their past (“Please think of a nostalgic event in your life. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel?”). In the control condition, participants were instructed to recall an ordinary memory (“Please bring to mind an ordinary event in your life. Specifically, try to think of a past event that is ordinary. Bring this ordinary experience to mind. Immerse yourself in the ordinary experience. How does it make you feel?”). After they read the instructions, they were asked to provide keywords related to their nostalgic/ordinary narrative and a written account of their nostalgic/ordinary memory with vivid and descriptive details, over the course of seven to ten minutes.

Face Stimuli

Faces for the emotional face discrimination task were derived from the NimStim face set (Tottenham et al., 2009). We used four emotional expressions: neutral, angry, fearful, and happy (see Figure 2.1 for an example). We morphed together several actors using bespoke software written in MATLAB (Version 7.4; Math Works, Natick, MA) to generate an averaged male and female image for each emotion, as described by Adams et al. (2010). We averaged each full emotional expression with that averaged gender's neutral face to create different levels of increasing affect intensity. Nine affect levels were created for presenting faces with different intensities (see Figure 2.2 for an example). The maximum morph level was set at 65% for angry and fearful expressions, and 60 % for happy expressions. In other words, stimulus materials were morphed between the average neutral face and an average emotional face, ranging from 100% neutral, to 65% neutral and 35% emotion (for angry and fearful faces), or 60% neutral and 40% emotion (for happy faces), in nine equal steps. 100% emotion was not presented to the participants to prevent the task from being too easy to discriminate. Stimuli were presented using MATLAB (Version 7.4; Math Works, Natick, MA), on a MacBook Pro (Apple Inc., USA) with a 13.3-inch (diagonal) LED-backlit monitor, and approximately 12.56° subtended angle at 55cm of viewing distance. We presented face stimuli for 500 ms, which was suitable with the literature and argued that differences between emotional faces and neutral faces were observable specifically between 200 and 550 ms after stimulus onset (Prins & Kingdom, 2018). Stimuli were presented as greyscale images within an elliptical mask to hide any external features of the face; that is, the faces were presented without visible hair, background content, or clothes.

Face Discrimination Task (FDT)

The participant's ability to discriminate emotional intensity across faces was assessed via the face discrimination task (Figure 2.3). The task lasted over the course of 30-40 minutes.

Nostalgia Proneness

We assessed nostalgia proneness with the seven-item Southampton Nostalgia Scale (SNS; Routledge et al., 2008) and the seven-item Past Positive Scale (PPS; Zimbardo & Boyd, 1999). The SNS includes four items that assess the importance of nostalgic engagement (e.g. “How significant is it for you to feel nostalgic?”; 1= *not at all*, 7= *very much*) and three items that assess the frequency of nostalgic experiences (e.g. “How often do you experience nostalgia?”; 1 = *very rarely*, 7 = *very frequently*). One item was reverse-scored. The responses showed high internal consistency ($\alpha = .94$, $M = 4.40$, $SD = 1.56$). The PPS, which is a sub-scale of the Zimbardo Time Perspective Inventory (ZTPI), includes items such as “On balance, there is much more good to recall than bad in my past”. These items were rated on a 6-point rating scale (1 = *very uncharacteristic*, 6 = *very characteristic*; $\alpha = .86$, $M = 4.18$, $SD = 1.41$).

Manipulation Check

We administered a manipulation check (Wildschut et al., 2006) two times throughout the experiment, one after the ERT ($\alpha = .96$, $M = 4.01$, $SD = 1.60$), and one after the FDT ($\alpha = .97$, $M = 3.60$, $SD = 1.54$), to evaluate the success of the nostalgia induction and gauge the nostalgia level. It consisted of three items (e.g. “Right now, I am having nostalgic feelings”), and the items were rated on a 6-point scale (1 = *strongly disagree*; 6 = *strongly agree*).

Empathy

We measured cognitive and affective empathy with the Questionnaire of Cognitive and Affective Empathy (QCAE; Reiners et al., 2011). Participants rated their level of agreement using a 4-point rating scale (1 = *strongly disagree*, 4 = *strongly agree*). The cognitive empathy facet ($\alpha = .90$, $M = 3.05$, $SD = 0.80$) evaluates the perspective-taking (e.g. “I can easily work out what another person might want to talk about”) and online simulation (e.g. “Before criticizing somebody, I try to imagine how I would feel if I was in their place”) sub-facets of empathy. The affective empathy facet ($\alpha = .80$, $M = 2.88$ $SD =$

0.88) assesses the emotion contagion (e.g. “I am happy when I am with a cheerful group and sad when the others are glum”), proximal responsivity (e.g. “It pains me to see young people in wheelchairs”), and peripheral responsivity (e.g. “I usually stay emotionally detached when watching a film”) sub-facets of empathy. We also summed the cognitive and affective empathy scores to provide the cumulative total empathy score ($\alpha = .89$, $M = 2.98$, $SD = 0.83$). Necessary items were reverse-scored before analysis.

Additionally, we used a shorter scale that includes empathy-related adjectives to assess state-level empathy following the ERT (Batson et al., 1987; Batson et al., 1983). The state-level empathy scale consists of 12 adjectives (SES; e.g. sympathetic, compassionate, soft-hearted, tender, warm, moved). The items were rated on a 6-point scale (1 = *strongly disagree*; 6 = *strongly agree*; $\alpha = .94$, $M = 3.64$, $SD = 1.50$). Each item was preceded by the stem “Thinking about this event…”, which refers to the event they recalled during the nostalgia induction.

Procedure

After informed consent was obtained, participants were randomly assigned to the experimental conditions (nostalgia vs. control). Once participants were allocated to conditions, they performed four practice trials to familiarise themselves with the procedure of the FDT, and followingly completed a series of questionnaires (SNS and PPS). Then, all of the participants underwent either a nostalgia ($n = 69$) or an ordinary ($n = 69$) induction with the ERT instructions, and completed the three-item manipulation check. Next, the FDT began, and participants were instructed to adjust the viewing distance between the screen and their eyes to approximately 55cm while sitting in front of the computer. Once adjusted, they were instructed to look at the white fixation cross in the middle of the screen, to provide a stable eye position, and to click on that cross to bring up two face images that expressed one of the angry, fearful, or happy emotions. Images were presented in a randomised order, and one of the two face images in the pair was always exhibiting a neutral expression. Neutral expressions randomly appeared on both the left and the right sides throughout the task. After the two images were displayed for 500 ms, the faces were masked, and the question ‘Which one is more X, left or right?’ (where X = angry, fearful, happy) appeared on the screen. With this question, participants were instructed to make a two-alternative forced-choice (2AFC) response. They were asked to indicate which image reflects the emotion (for the different emotions presented at each trial) more intensely, by pressing the right or left button. Participants had unlimited time to respond but were advised to respond as quickly and accurately as possible. In total, 432 trials were shown in eight blocks (two actors [one male, one female] x three emotions x nine morph levels x eight repetitions), and participants were allowed to take breaks when necessary. After they completed the FDT, they were then instructed to write four keywords that summarise the nostalgic or ordinary memories they recalled in the first phase (i.e. nostalgia manipulation refresher). After this, they completed the manipulation check for the second time along with, SES, and QCAE.

Finally, participants provided demographic information and were fully debriefed about the purpose of the experiment[1]. Overall, the procedure lasted approximately an hour, and was completed in a single session in a laboratory setting.

Data-analytic strategy

To test the hypotheses we conducted a set of analyses. To analyse the face discrimination data, we averaged each emotion category across repetitions, giving the proportion of the correct answers as the dependent variable. To summarise the data for the analysis, we fit the proportion correct data as a function of morph level for each emotion,

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[1] We collected additional measurements for exploratory purposes (administered at a single time): a 20-item the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), a 10-item Ruminative Responses Scale (Brooding and Reflection subscales; Treynor, Gonzalez, & Nolen-Hoeksema, 2003) a 28-item Nostalgia Functions Scale (NFS; Hepper et al., 2012; Routledge et al., 2011; Sedikides et al., 2015b; Wildschut et al., 2010). Results regarding these measurements will not be presented.

and each participant, using a cumulative Gaussian distribution, which is a standard for psychophysiological procedures such as our two-alternative forced choice task using the Palamedes package in MATLAB (Version 7.4; Math Works, Natick, MA; Prins & Kingdom, 2018). From these fits, we obtained threshold values at the 50% performance ($M = 0.26$, $SD = 0.07$) and the slope of the function ($M = 7.66$, $SD = 5.19$) for each emotion (i.e. angry, fearful, happy). Threshold, which is an important parameter to demonstrate the participant's sensitivity to the stimulus intensity and the contrast associated with a particular performance level (i.e. 50% correct). The slope of that function is also an important parameter to determine how contrast sensitivity and signal strength are related, considering the shallow or steep shape of the slope (Shen, Richards & Dai, 2017; Wallis et al., 2013). In other words, the slope is the precision (or uncertainty) of the estimates. While a higher slope would indicate a greater ability to discriminate at the threshold, a lower threshold value would indicate better sensitivity to the stimulus (Prins & Kingdom, 2018). We used both threshold and slope values as our face categorisation data. Our hypothesis is that we would find group-level differences between our nostalgia and control conditions for threshold values.

We analysed group differences in continuous variables (i.e. manipulation check, state empathy, cognitive empathy and affective empathy) using one-way ANOVA.

To assess the main effect of nostalgia induction (state nostalgia) on emotional face categorisation, we conducted a 3 x 2 mixed-model ANOVA with a within-subjects factor of emotion (angry, fearful, happy) and a between-subjects factor of condition (nostalgia, control). We explored the data and checked if data analytic assumptions were met because some of the underlying assumptions for the F test were not met. We reported Welch's F-test results as suggested (Delacre et al., 2019).

To analyse the relationships among the variables of interest, we calculated the correlation coefficients. Next, we conducted a mediational analysis (5,000 bootstrapped samples, using PROCESS; Hayes, 2013) to test whether the relation between nostalgia proneness and emotional face categorisation (for angry, fearful and happy emotions) can be explained by empathy. We used Statistical Package for Social Sciences (SPSS) version 28 for the analysis. There were no missing data.

Results

Manipulation Check

Analysis of the first instance of the manipulation check, assessed prior to the FDT, revealed that participants in the nostalgia condition (M = 4.62, SD = 1.30) reported higher nostalgia than those in the control condition (M = 3.41, SD = 1.51), F(1, 132.85) = 25.76, p < .001, η_p^2 = .159. The second manipulation check, which was delivered approximately 30-40 minutes after the first one when the participants had completed the FDT, indicated that participants in the nostalgia condition (M = 12.19, SD = 4.12) continued to feel more nostalgic than those in the ordinary condition (M = 9.43, SD = 4.40), F(1, 135.42) = 14.40, p < .001, η_p^2 = .096. The nostalgia manipulation was effective as assessed prior to the face categorisation task, and its effect still held after the task; however, the effect was decreased.

Between-group Differences for Emotional Face Categorisation

The calculated threshold and slope values were used to explore the participant's sensitivity to the stimulus intensity and categorisation uncertainty, respectively. We conducted a 3 x 2 mixed-model ANOVA with a within-subjects factor of emotion (angry, fearful, happy) and a between-subjects factor of condition (nostalgia, control) on the sensitivity to the stimulus intensity (threshold) and categorisation uncertainty (slope) separately. We presented the descriptive statistics in Table 2.1. For all the ANOVAs, degrees of freedom were Greenhouse-Geisser corrected where appropriate.

The analysis did not reveal a significant main effect of condition on the threshold across angry, fearful and happy faces, $F(1,136) = 0.08$, $p = .772$, $\eta_p^2 = .001$, indicating that there was no significant difference between nostalgia and control conditions in terms of the sensitivity threshold. The main effect of the emotion on the threshold was significant, $F(1.67, 227.46) = 4.16$, $p = .023$, $\eta_p^2 = .030$. There was no significant interaction between the condition and emotion in terms of threshold, $F(1.67, 227.46) = 0.10$, $p = .869$, $\eta_p^2 = .001$. The results indicated that participants' level of sensitivity to the signal (emotional intensity) was not affected by the nostalgia induction.

The analysis did not reveal a significant main effect of condition on the slope across angry, fearful and happy faces, $F(1, 136) = 0.13$, $p = .715$, $\eta_p^2 = .001$. The main effect of the emotion on the slope was significant, $F(1.96, 266.03) = 25.30$, $p < .001$, $\eta_p^2 = .000$. There was no significant interaction between the condition and emotion, $F(1.96, 266.03) = 0.05$, $p = .948$, $\eta_p^2 = .000$, implying that there is no evidence that the categorisation uncertainty was affected differently by the condition assignment of nostalgia or control conditions.

Between-group Differences in Empathy

A one-way ANOVA assessing the effect of experimental conditions on state-level empathy was significant, as assessed through the 12-item empathy scale. Participants in the nostalgia condition ($M = 4.02$, $SD = 0.99$) reported more empathy than did those in the control condition ($M = 3.27$, $SD = 1.19$), $F(1, 131.66) = 16.51$, $p < .001$, $\eta_p^2 = .108$.

The two conditions (nostalgia vs. control) did not differ on empathy, as assessed through the QCAE, in terms of affective empathy ($F[1, 134.43] = 0.02$, $p = .898$, $\eta_p^2 = .000$), and its sub-facets: emotion contagion ($F([1, 135.89] = 1.02$, $p = .314$, $\eta_p^2 = .007$), proximal responsivity ($F[1, 130.77] = 0.00$, $p = 1.00$, $\eta_p^2 = .000$), and peripheral responsivity ($F[1, 135.48] = 0.78$, $p = .377$, $\eta_p^2 = .006$). The two groups were marginally different with respect to cognitive empathy ($F[1, 132.52] = 3.94$, $p = .049$, $\eta_p^2 = .028$).

Here, participants in the nostalgia condition (M = 3.13, SD = 0.43) reported more cognitive empathy than those in the ordinary condition (M = 2.97, SD = 0.51). Participants in the two conditions did not differ on cognitive empathy's sub-facets: perspective taking (F[1, 127.38] = 2.40, p = .124, η_p^2 = .017), and online simulation (F[1, 135.09] = 3.66, p = .058, η_p^2 = .026). In terms of total empathy, there was no significant difference between the experimental groups (F[1, 129.58] = 1.19, p = .278, η_p^2 = .009).

Zero-order Correlations

We computed correlation coefficients among key study variables. We presented the relation between trait nostalgia, the sensitivity to the stimulus intensity (threshold), and the precision of responses at the threshold (slope) in Table 2.2. Nostalgia proneness as assessed through SNS was positively related to the precision of responses at the threshold for angry and happy faces. However, there was no significant correlation between nostalgia proneness (as assessed through SNS) and the categorisation threshold for angry, fearful or happy faces.

Nostalgia proneness as assessed through PPS was positively related to the precision of responses at the threshold for happy faces. It was also negatively correlated with the categorisation threshold for angry faces.

We presented the correlations between trait nostalgia, state empathy, cognitive empathy (perspective-taking and online simulation subscales), and affective empathy (emotion contagion, proximal responsivity, and peripheral responsivity subscales) in Table 2.3. There was a significant and positive relationship between all the variables.

Finally, we presented the relationship between state empathy, cognitive empathy (perspective taking and online simulation subscales), affective empathy (emotion contagion, proximal responsivity, and peripheral responsivity subscales), the sensitivity to the stimulus intensity (threshold), and the precision of responses at the threshold (slope) in Table 2.4. There were significant and positive correlations among slope values for angry faces and empathy (QCAE total), affective empathy, and peripheral responsivity. There were significant and positive correlations among slope values for fearful faces and peripheral responsivity. There were significant and positive correlations among slope values for happy faces and empathy (QCAE total), online simulation, affective empathy, proximal responsivity and peripheral responsivity. There were significant and negative correlations among threshold values for fearful faces and peripheral responsivity. Lastly, there were significant and negative correlations among threshold values for happy faces and peripheral responsivity

In summary, the findings suggest that nostalgia proneness may have a direct effect on the sensitivity to the intensity of emotional faces, and the precision of responses. Furthermore, there appears to be an indirect effect of nostalgia proneness on facial emotion categorisation via empathy. Consequently, we conducted a mediation analysis to test this hypothesis.

Mediation Analysis

Subsequently, we conducted a mediational analysis (5,000 bootstrapped samples and 95% confidence interval, using PROCESS Model 4; Hayes, 2013) to test whether the relation between nostalgia proneness and emotional face categorisation (for angry, fearful, and happy emotions) can be explained by empathy. We conducted separate mediation analyses using nostalgia proneness, as assessed through SNS and PPS, to determine its impact on the sensitivity to the stimulus intensity (threshold) and the precision of responses (slope) for angry, fearful, and happy faces. We used empathy as a mediator in the analysis, conducting separate mediation analyses for state empathy, cognitive empathy, and affective empathy.

Results indicated that state empathy has not emerged as a mediator between nostalgia proneness and either the sensitivity to the stimulus intensity (threshold) or the precision of responses (slope) for any of the emotional faces. Additionally, when emotions are considered separately, empathy was not found to mediate the relationship between nostalgia proneness and sensitivity to the intensity of fearful facial expressions, and uncertainty around the threshold estimate for fearful faces. Table 2.5 describes the significant mediation test results between the nostalgia proneness (as assessed through PPS) and the sensitivity to the intensity of angry facial expressions (threshold), mediated by empathy. There were no significant mediation results with the remaining variables (i.e. nostalgia proneness as assessed through SNS, sensitivity to the intensity of fearful and happy facial expressions, and empathy). Table 2.6 describes the significant mediation test results between nostalgia proneness (assessed through SNS and PPS) and the precision of estimates for angry and happy facial expressions at a threshold point (slope). The mediation was conducted separately for each, mediated by empathy in separate mediation analyses. There were no significant mediation results with the remaining variables (i.e. state nostalgia, nostalgia proneness as assessed through SNS and PPS, the precision of the estimates of fearful facial expressions, and empathy).

Discussion

The results partially support the hypothesis that trait nostalgia is related to emotional facial categorisation abilities, and empathy mediates this relationship. In detail, regarding the assessment of state nostalgia following the experimental manipulation, participants in the nostalgia condition reported greater state empathy than those in the control condition. However, there was not a significant difference between the experimental conditions for cognitive and affective empathy (with their subscales). Additionally, the two groups did not differ in facial emotion categorisation. We will revisit those results in the General Discussion.

On the other hand, our findings suggested interesting relationships among the key variables, which will be comprehensively investigated in Experiment 2, wherein participants will be prompted to provide empathy-related responses.

Experiment 2

Experiment 1 has suggested associations between nostalgia proneness, empathy, sensitivity to the stimulus intensity, and precision of the responses, and that empathy is a mediator among this nostalgia proneness and emotional face categorisation link. We then investigated these associations further in a subsequent experiment that was designed to elicit empathy-based responses from participants while also directly assessing empathic responses to facial stimuli.

Given that attachment security enables empathy (Mikulincer et al., 2001; Mikulincer et al., 2005), nostalgia facilitates secure attachment (Juhl et al., 2020; Wildschut et al., 2006), and attachment security mediates the relationship between nostalgia and empathy (Juhl et al., 2020), we theorised that secure attachment may also mediate the relationship between trait nostalgia and emotional face categorisation, in addition to empathy. Thus, in Experiment 2, we also examined the role of attachment security (the theoretical reason is rooted in attachment theory, as mentioned in the introduction) on the relation between nostalgia proneness, and emotional face categorisation. Additionally, since there was no significant difference between the experimental groups who underwent ERT induction in Experiment 1, we excluded ERT from the design and aimed to focus on the correlations with more detail.

The objectives of Experiment 2 are as follows: (a) to replicate the correlational findings of Experiment 1; (b) to diversify the assessment of empathy with a novel evaluation method including an emotional face rating task; and (c) to explore the role of attachment security on the relation between nostalgia proneness, and emotional face categorisation along with empathy. We hypothesised that nostalgia proneness will be related to empathy and attachment security, and that empathy and attachment security would separately mediate nostalgia's effect on emotional face categorisation.

Methods

Participants

In order to determine the sample size needed for testing the study hypotheses, we performed an apriori power assessment utilizing G*Power 3.1 (Faul et al., 2007). The findings revealed that a sample size of 153 participants would be necessary to attain 80% power for detecting small to medium relationships (*rs* = 0.20) at a significance level of $\alpha = .05$. We recruited one hundred and sixty-two participants (53 men, 106 women, 2 other, 1 prefer not to say) online via Prolific. They ranged in age from 18 to 70 years (M_{age} = 33.12, SD_{age} = 13.54). Eleven participants failed to complete the Face Rating and Face Discrimination tasks, and were excluded from the data set. Therefore, all subsequent statistical analyses are based on one hundred and fifty-one participants. Eighty-five per cent of the participants stated that their first language is English. We remunerated them £5 per hour. All of the participants gave informed online consent through Qualtrics Survey Software to participate in the study. The experimental protocol was approved by the Ethics Committee of the University of Southampton (Reference: 31640.A3).

Materials and Procedure

Face Stimuli

We used the same face set from the NimStim (Tottenham et al., 2009). Two sets of face stimuli were generated for two distinct blocks of tasks using the same morphing algorithm as was used in Experiment 1 (Adams et al., 2010). For the first block, the Face Rating Task (FRT), we used emotional faces that were morphed and generated in five equal steps. For the second block, the Face Discrimination Task (FDT), we used the same nine morph levels as featured in Experiment 1. The maximum emotion level was set ranging from 100% neutral to 65% neutral and 35% emotion for angry or fearful faces, or 60% neutral and 40% emotion for happy faces, for both blocks. The face stimuli were presented as greyscale images, with no visible hair, background features, or clothing. We presented both tasks online via "Just Another Tool for Online Studies" (JATOS; a web server used to host JavaScript-based online research projects; Lange et al., 2015), with an embedded link into Qualtrics Survey Software. Due to online experimental conditions, we used validated adjustment methods (i.e. the Card Task and the Blind Spot Task) before starting the tasks to control the participants' viewing distance and the stimulus size (Li et al., 2020; Figure 2.4). In the card task, participants were instructed to place a credit card or a card of equal size on the screen and manipulate a slider until the image of the card on the screen matched the actual size of the physical card. In the Blind Spot task, participants fixed their gaze on a static black square with their right eye closed, while a red dot moved repeatedly from right to left. Participants were required to press the spacebar when they perceived the red dot as disappearing. Subsequently, we computed the distance between the centre of the black square and the centre of the red dot at the moment it vanished from the eyesight.

Face Rating and Discrimination Tasks

We used two distinct tasks in Experiment 2. We called the first block 'the Face Rating Task (FRT)'. We created this task to measure participants' cognitive empathy, affective empathy, and empathic accuracy levels. The second block comprised the same Face Discrimination Task as in the first experiment to measure participants' facial emotion categorisation abilities.

Block 1 – Face Rating Task (FRT). To assess empathy multidimensionally, we created a Face Rating Task (Figure 2.5). We aimed to create a novel task in which we could observe and measure empathic behaviour besides the self-report measurement (Zaki et al., 2008; Zaki et al., 2009). We were inspired by the Multifaceted Empathy Test, a photo-based empathy measurement, while creating the questions to measure cognitive and affective empathy (MET; for more information see Dziobek et al., 2008). We created the questions to measure empathic accuracy based on the Empathic Accuracy Task (Mackes et al., 2018).

Block 2 – Face Discrimination Task (FDT). Participants' ability to process emotional expressions across faces was evaluated with the second block, as in Experiment 1 (see Figure 2.3).

Nostalgia Proneneness

Participants completed the SNS (α = .94, *M* = 4.67, *SD* = 1.50) and PPS (α = .89, *M* = 5.11, *SD* = 1.62) as described in Experiment 1. Additionally, they completed the five-item Nostalgia Proneness Index (NPI; Cheung, Sedikides & Wildschut, 2017). The NPI consists of five statements describing typical features of nostalgia (e.g. "I remember shared experiences with my family and friends"). Participants were instructed to rate how frequently they engaged in these actions (1 = *I do this rarely*, 7 = *I do this very often*) and how important they perceived each action to be (1 = *this is not important to me*, 7 = *this is very important to me*). Ten responses (five behaviours x two ratings) were averaged to generate a nostalgia proneness index (α = .85, *M* = 4.64, *SD* = 1.64).

Empathy

Participants completed QCAE as described in Experiment 1. After reverse scoring the necessary items, the total empathy (α = .90, *M* = 2.94, *SD* = 0.80), cognitive empathy (α = .90, *M* = 3.00, *SD* = 0.77), and affective empathy (α = .81, *M* = 2.86, *SD* = 0.86) scores (and their subscales) were calculated. Additionally, we used the Interpersonal Reactivity Index to measure different dimensions of empathy (IRI; Davis, 1980). The IRI consists of four subscales: perspective taking (e.g. "I try to look at everybody's side of a disagreement before I make a decision"; α = .83, *M* = 3.63, *SD* = 0.95), fantasy (e.g. "After seeing a play or movie, I have felt as though I were one of the characters"; α = .82, *M* = 3.29, *SD* = 1.20), empathic concern (e.g. "Other people's misfortunes do not usually disturb me a great deal"; α = .82, *M* = 3.78, *SD* = 1.02), and personal distress (e.g. "Being in a tense emotional situation scares me"; α = .83, *M* = 2.84, *SD* = 1.12). The scale contained 28 items and participants responded on a 5-point scale (1 = *does not describe me well*, 5 = *describes me very well*).

Attachment Security

We administered the Security subscale of the Attachment Style Questionnaire (ASQ; Hofstra, Van Oudenhoven & Buunk, 2005) to assess attachment security. It included eight items (1 = *strongly disagree*, 5 = *strongly agree*; α = .84 *M* = 3.80, *SD* = 0.99) assessing attachment security (e.g. "I feel uncomfortable when relationships with other people become close"). The ASQ was well-suited for our needs as a mediator, given its inclusion of a subscale that measures individuals' attachment security levels. Necessary items were reverse-scored before analysis.

Procedure

After the participants gave online informed consent, they completed six questionnaires (SNS, NPI, PPS, ASQ, QCAE and IRI). They were instructed to sit in front of their computer and adjust the stimulus size with the Card Task and the viewing distance between the screen and their eyes to approximately 55cm with the Blind Spot Task. Then, they were allowed to complete six practice trials of the two blocks of the FRT and FDT. Afterwards, they were instructed to complete the FRT. In this task, they were asked to click on a central black fixation cross on the screen to bring up one face image that expressed one of the angry, fearful, or happy emotions with different intensities. Each trial consisted of three questions that were designed to assess participants' empathic accuracy level and cognitive and affective empathy level toward the emotional faces that appeared on the screen. Participants were shown one face stimuli with different intensities on each trial for 500ms before being masked, and they were asked to report, "Which emotion was the person expressing most strongly?", to assess cognitive empathy. They had to choose the emotion that was presented by the image among the three options listed below the face (options = angry, fearful, happy). Then, they were asked to rate the intensity of emotion with the following instruction, "Please rate the intensity of the emotion", to assess empathic accuracy. They were instructed to use the slider bar to state their answer between 'no emotion' and 'strong emotion'. Finally, the same facial stimulus was presented again and participants were asked to report, "When you look at this picture, how much can you feel what this person is feeling?", using the slider bar below the picture (from not at all to very much) to measure affective empathy. A total of 120 trials, consisting of combinations of two actors (one male, one female), three emotion levels (angry, fearful, happy), five morph levels and four repetitions per condition, were presented in random order. Participants were allowed to take breaks when necessary. Afterwards, they were instructed to complete the FDT as described in Experiment 1. Finally, participants provided demographic information and were fully debriefed about the purpose of the experiment[2]. Overall, the procedure lasted approximately an hour, and was completed online in a single session.

Data-analytic strategy

To analyse the face discrimination data, we averaged each emotion category across repetitions, giving the proportion of the correct answers as the dependent variable as explained in Experiment 1. We calculated the threshold at the 50% performance (M = 0.01, SD = 0.079) and the slope of the function (M = 8.31, SD = 3.45) for each emotion (i.e. angry, fearful, happy). We used the threshold and slope values as our face categorisation data. We have presented the summary graph of face discrimination data in Figure 2.6. To analyse the face rating data, we calculated the proportion of the correct responses for cognitive empathy. We used the Pearson correlation values between the morph level and

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[2] We collected additional measurements for exploratory purposes (administered at a single time): a 36-item the Experiences in Close Relationships-Revised (ECR-R) Questionnaire (Fraley, Waller & Brennan, 2000), an 15-item The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003. Results regarding these measurements will not be presented.

the measurement in focus, for the empathic accuracy and affective empathy. We have presented the summary graph of the face rating data in Figure 2.7 and Figure 2.8.

To analyse the associations among the variables of interest, we calculated the correlation coefficients. Next, we planned to conduct a mediational analysis (5,000 bootstrapped samples, using PROCESS; Hayes, 2013) to check the replicability of Experiment 1, and whether the relation between nostalgia proneness and emotional face categorisation (for angry, fearful and happy emotions) can be explained by empathy and attachment security. We used SPSS version 28 for the analysis. There were no missing data.

Results

Zero-order Correlations

We computed means, standard deviations, and correlation coefficients among key study variables. We presented the relationship between trait nostalgia, sensitivity to the stimulus (threshold), and precision (or uncertainty) of responses at threshold (slope) in Table 2.7. All but one of these associations were statistically non-significant, the exception being the negative association between nostalgia proneness (as assessed through PPS) and the precision of responses for angry facial expressions.

We presented the correlations between trait nostalgia, cognitive empathy (as assessed through QCAE and Face Rating Task), affective empathy (as assessed through QCAE and FRT), empathic accuracy (as assessed through FRT), trait empathy (as assessed through IRI), and attachment security (as assessed through ASQ) in Table 2.8. There was a significant and positive relationship between trait nostalgia, affective empathy, cognitive empathy, (via QCAE), trait empathy (via IRI), and attachment security (see Table 2.8 for detailed information). There was also a significant negative correlation between trait nostalgia (via NPI and PPS) and empathic accuracy (via FRT).

Finally, we presented the associations between the sensitivity to the stimulus intensity (threshold), the precision of responses at the point of threshold (slope), cognitive empathy (as assessed through QCAE and FRT), affective empathy (as assessed through QCAE and FRT), empathic accuracy (as assessed through FRT), trait empathy (as assessed through IRI), and attachment security (as assessed through ASQ) in Table 2.9. Specifically, there was a positive relationship between cognitive empathy (via FRT), the precision of responses to angry, fearful and happy facial expressions, and the sensitivity to the intensity of angry facial expressions. There was also a significant negative correlation between cognitive empathy (via FRT) and sensitivity to the intensity of fearful facial expressions. There was a positive relationship between empathic accuracy (via FRT), the precision of responses to angry, fearful and happy facial expressions, and the sensitivity to the intensity of angry facial expressions. There was also a significant negative correlation between empathic accuracy (via FRT) and sensitivity to the intensity of fearful facial expressions. There was a positive relationship between affective empathy (via FRT), and the precision of responses to angry, fearful and happy facial expressions. There was a positive association between categorisation uncertainty for the threshold estimate (slope) of fearful faces and peripheral responsivity (as assessed through QCAE). Finally, There was no significant correlation between the threshold values (for each emotion), the slope values (for each emotion) and attachment security.

We did find noteworthy significant associations between the variables of interest; however, these relationships did not allow us to perform further mediations to support our hypotheses.

Discussion

In Experiment 2, we replicated several correlations and found that some of the relationships existed as in Experiment 1. In particular, results suggested that there was a significant relationship between nostalgia proneness and uncertainty of the estimates for angry faces, as well as between nostalgia proneness and empathy (trait, cognitive, and affective empathy). Additionally, we found that the precision of responses for fearful faces was associated with peripheral responsivity, as we had observed in Experiment 1.

Furthermore, we extended our findings by using the data that we obtained through the FRT. We showed that there was a significant link between the sensitivity to the intensity of angry facial expressions, cognitive empathy (measured using FRT), and empathic accuracy (also measured using FRT). Additionally, we demonstrated that nostalgia proneness was connected to empathic accuracy, as measured by FRT.

Despite discovering interesting correlations, our theoretical hypothesis regarding the mediating effect of empathy or attachment security on the relationship between nostalgia proneness and emotional face discrimination was not substantiated. We will present a comprehensive discussion of these findings in the General Discussion.

General Discussion

Across these two studies, we aimed to find an answer to the question, "Does nostalgia make facial information more meaningful?". In Experiment 1, we obtained various outcomes that lent support to some of our hypotheses. In contrast, Experiment 2 yielded significant correlations between the variables of interest, yet we did not observe further mediation outcomes.

Summary of Findings

In Experiment 1, we proposed three hypotheses, based on previous findings demonstrating the relation between nostalgia and empathy, and between empathy and face categorisation (Balconi & Bortolotti, 2013; Balconi & Canavesio, 2016a; Juhl et al., 2020; Zhou et al., 2012). Given that nostalgia is a social emotion (Sedikides et al., 2006; Zhou et al., 2012), it was hypothesised that nostalgia induction (Sedikides et al., 2015) influences emotional face categorisation abilities, which is one of the fundamental ways of processing social information (Decety et al., 2014). The outcomes of the study concerning the emotional face categorisation indicated that the sensitivity to the intensity of angry, fearful, and happy emotions across faces, as well as the precision (or uncertainty) of the responses at the threshold point, did not significantly vary between the nostalgia and control conditions. One reason for this result may be that emotional face categorisation skills have already been acquired from a very young age, and a brief nostalgia manipulation is incapable of influencing well-established individual differences in face categorisation ability. Leppänen et al. (2007) examined emotional face processing in seven-month-old infants and young adults regarding neutral, fearful, and happy facial expressions. They found that individuals have different responses to different emotional expressions even in the first year of life.

Regarding the summary of our correlational results, we have discovered significant relationships between nostalgia proneness and emotional face discrimination. Specifically, our findings indicate a relation between nostalgia proneness and the threshold values for angry faces. This suggests that participants with higher levels of nostalgia proneness may exhibit greater sensitivity to the information conveyed in the stimulus, thus detecting the difference between the emotion/no emotion pairs in a lower threshold. Moreover, our results revealed a significant correlation between nostalgia proneness and the slope values for both angry and happy faces; suggesting that participants with higher nostalgia proneness may be more precise in their categorisation ability for angry and happy faces, thus exhibiting steeper slopes. We also observed divergent results with our two different nostalgia proneness scales (i.e., SNS and PPS). It is important to note that, despite measuring the same construct, the scales may differ in their methodological approaches, such as item wording. These methodological differences can affect the correlations observed with other variables, particularly if the variables being assessed are sensitive to specific aspects of the construct that are captured differently across the scales.

Furthermore, we have observed significant associations between nostalgia proneness and empathy, which include trait empathy, affective empathy, and cognitive empathy. These results broadly support the findings of other studies, highlighting the relationship between empathy and nostalgia proneness (Cheung et al., 2017; Juhl et al., 2020). Additionally, we have identified correlations among slope values for angry faces and empathy, affective empathy, and peripheral responsivity. We have also noted relationships between slope values for fearful faces and peripheral responsivity, as well as slope values for happy faces and empathy, online simulation, affective empathy, proximal responsivity, and peripheral responsivity. Finally, we have found significant correlations between threshold values for fearful faces and peripheral responsivity, as well as threshold values for happy faces and peripheral responsivity. These findings also corroborate past research regarding the relationship between empathy and emotional face discrimination (Andréasson & Dimberg, 2008; Balconi, Bortolotti & Gonzaga, 2011; Balconi & Bortolotti, 2013; Balconi & Canavesio, 2016a).

Regarding our mediational analysis, the significant mediation test results indicate that empathy (cognitive empathy and perspective-taking subscale) mediates the relationship between nostalgia proneness and sensitivity to the intensity of angry facial expressions (threshold). Results also demonstrated that empathy (trait empathy, affective empathy, peripheral responsivity subscale, and online simulation subscale) mediates the relation between nostalgia proneness and precision of the estimates of angry and happy facial expressions at a threshold point (slope).

Experiment 2 replicated some of the correlations found in Experiment 1, including a significant relationship between nostalgia proneness and uncertainty of estimates for angry faces, and between nostalgia proneness and empathy (trait empathy, cognitive empathy, and affective empathy). The results also demonstrated that the precision of responses for fearful faces was associated with peripheral responsivity, as demonstrated in

Experiment 1. Moreover, our study broadened its scope by using the data gathered from the Face Rating Task, where we found a significant correlation between the sensitivity to the intensity of angry facial expressions, cognitive empathy (measured by FRT), and empathic accuracy (also measured by FRT). Consistent with the literature, we found a significant relationship between attachment security and nostalgia proneness, and between attachment security and empathy (Gillath et al., 2005; Juhl et al., 2020; Mikulincer et al., 2001, 2005; Mikulincer & Shaver, 2017). However, inconsistent with our expectations, we did not find a significant relationship between attachment security and emotional face categorisation. We also could not replicate the mediational results of the first experiment, and did not provide empirical evidence to support our hypotheses. These findings did not prove the expectation that attachment security is a mediator between the nostalgia proneness and emotional face discrimination link. The absence of statistically significant correlations among the variables of interest may be due to the data collection strategy that we applied in the second experiment.

Implications

The findings of the present research have implications for the literature. This study suggested a potential positive implication of nostalgia proneness, as it was associated with a greater sensitivity to the intensity of certain emotions that play a crucial role in everyday social interactions (Montagne et al., 2007). The relation between nostalgia, which is a social emotion, and emotional face discrimination ability, which is an essential way of understanding others' feelings, has been a notable empirical finding. This association aids in comprehending how sensitive individuals are to facial information and which underlying mechanisms help them in this process. This study represents a novel investigation into the direct examination of the relationship between nostalgia, empathy, and emotion categorisation through facial expressions.

Concerning the practical implications for clinical psychology, nostalgia may be considered as an intervention to respond to real-world challenges, such as social anxiety. One condition wherein social cues become difficult is social anxiety disorder (SAD), which is characterised by having weak social ties and the avoidance of social relationships and activities (The National Institute for Health and Care Excellence, [NICE], 2013). Additionally, socially anxious individuals have been found to display reduced attention to emotional facial expressions (Rossignol et al., 2012). Given that nostalgia fosters empathy and social connectedness, it could also decrease anxiety by helping individuals with SAD improve their ability to be empathetic, strengthen their social bonds, and have a sense of social connectedness (Abeyta et al., 2015a). Additionally, given the relationship we have demonstrated between nostalgia proneness and emotional face categorisation, nostalgia may have the potential to enhance the sensitivity of socially anxious individuals to emotional intensity in facial expressions and improve their attention to cues across faces.

Limitations and Future Directions

One possible limitation of our study is that the experimental settings were not standardized across both studies. In Experiment 1, we collected data in a laboratory setting, while in Experiment 2, we used an online design to recruit participants. In Experiment 2, although we used a reliable method to adjust the facial stimuli (i.e. the Card Task and the Blind Spot Task; Li et al., 2020), we did not have control over whether participants had appropriately adjusted the stimulus size and their viewing distance before starting face discrimination and face rating tasks. Furthermore, the absence of attention controls during the experiments prevented us from ruling out the possibility that participants were not paying sufficient attention to each scale and task. This could be a contributing factor to the absence of reproducibility in the correlation and mediation results. Nevertheless, in future studies, it may be beneficial to use more controlled experimental settings.

Another potential limitation concerned nostalgia manipulation in Experiment 1. Although the nostalgia induction method used in Experiment 1 has been validated (Sedikides et al., 2015), it is possible that the duration of the induction, which lasted only seven to ten minutes in a single session, may not have been sufficient to evoke a strong nostalgic experience. Additionally, some participants provided only brief descriptions of nostalgic and ordinary events, indicating a lack of effort on their part, which could have impacted the effectiveness of the induction. Furthermore, the experience of nostalgia may have vanished immediately upon focusing on the FDT. These factors may account for the lack of significant differences observed between the nostalgia and control conditions concerning emotional face discrimination. Hence, further studies could consider using more extended or more immersive nostalgia inductions to elicit a more intense nostalgic experience, and to increase the impact of the nostalgia induction (e.g. via Virtual Reality; music, Barrett et al., 2010; or scent, Reid et al., 2015).

Another limitation concerns Face Discrimination and Face Rating tasks. As explained in the methods, we used a repetitive task presenting many facial stimuli with different intensities. It is possible that some visual fatigue and habituation could have occurred due to the repetition of facial stimuli. Additionally, while we made an effort to present the facial emotions in a way that closely resembled real-life occurrences, we employed a morphing algorithm to adjust the intensity of emotions. This method may have resulted in excessive and unrealistic facial expressions. Lastly, we employed static images of facial expressions, which may not fully capture the richness and complexity of dynamic emotional expressions. The use of dynamic facial expressions in future studies may provide a more realistic and ecologically valid representation of emotional expression. These limitations should be taken into consideration while interpreting the results. Further research could explore the generalisability of our findings by using different sets of facial stimuli, incorporating both static and dynamic expressions (e.g. a static set of pictures, Ekman & Friesen, 1976; Amsterdam Dynamic Facial Expression Set, Van der Schalk, Hawk, Fischer & Doosje, 2011).

Finally, while our first experiment provides initial insights into the potential mediating role of empathy in the relationship between nostalgia proneness and emotional face discrimination, the lack of replication in the second experiment requires further investigation of the underlying factors that may have contributed to this inconsistency. Moreover, it is important to note that the correlational nature of both studies prevents the drawing of causal inferences. Thus, a future study may employ another experimental design to provide a more comprehensive understanding of the potential mechanisms by which nostalgia influences emotional face categorisation through empathy, and to address the question of whether nostalgia enhances sensitivity to facial cues.

Conclusion

In two experiments, we attempted to demonstrate the influence of nostalgia on emotional face categorisation, and we assessed the mediators which facilitate the possible nostalgia and face categorisation link. In Experiment 1, our findings documented that the sensitivity to the stimulus intensity and the precision or uncertainty of responses at the threshold point did not differ between nostalgia and control conditions. As such, we did not provide evidence of the effect of state nostalgia on the categorisation of emotional facial expressions. On the other hand, our findings suggested a significant link between nostalgia proneness, sensitivity to the stimulus intensity, and the precision of the responses, with empathy as a successful mediator in this link. However, those results were not replicated in our subsequent experiment and failed to suggest a significant association among nostalgia proneness, empathy, attachment security, and emotional face categorisation. In conclusion, this study is not without its limitations, and further research is needed to fully understand the underlying mechanisms of these relationships.

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Tables

Table 2.1

Means and Standard Deviations for Thresholds and Slopes Across Emotions and Experimental Conditions

Face Categorisation	Emotion	Nostalgia Condition (*n* = 69)		Control Condition (*n* =69)	
		M	*SD*	*M*	*SD*
Threshold	Angry	0.25	0.07	0.25	0.07
	Fearful	0.26	0.07	0.26	0.07
	Happy	0.26	0.06	0.26	0.05
Slope	Angry	7.80	5.85	7.41	4.59
	Fearful	6.60	4.90	6.42	4.91
	Happy	9.02	6.29	8.71	4.46

Table 2.2

Descriptive Statistics and Correlations Among Trait Nostalgia and Emotional Face Discrimination (Slope and Threshold) in Study 1 (n = 138)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1. Angry slope	7.60	5.24	—							
2. Fearful slope	6.51	4.89	.72**	—						
3. Happy slope	8.86	5.43	.70**	.75**	—					
4. Angry threshold	0.25	0.07	.09	-.12	-.11	—				
5. Fearful threshold	0.26	0.07	-.24**	-.13	-.23**	.35**	—			
6. Happy threshold	0.26	0.06	-.23**	-.28**	-.22**	.53**	.62**	—		
7. Nostalgia proneness (SNS)	4.40	1.34	.19*	.11	.17*	-.05	.03	-.01	—	
8. Nostalgia proneness (PPS)	4.18	1.04	.11	.17	.17*	-.22*	-.06	-.13	.54**	—

*Note***.** *M* and *SD* are used to represent mean and standard deviation, respectively.

* $p < .05$; ** $p < .001$.

Table 2.3

Descriptive Statistics and Correlations Among Trait Nostalgia and Empathy (State, Cognitive and Affective) in Study 1 (n = 138)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11
1. Nostalgia proneness (SNS)	4.40	1.34	—										
2. Nostalgia proneness (PPS)	4.18	1.04	.54**	—									
3. Empathy total (QCAE)	2.96	0.40	.44**	.46**	—								
4. Cognitive empathy	3.05	0.48	.31**	.41**	.81**	—							
5. Perspective taking	3.04	0.58	.25**	.39**	.73**	.89**	—						
6. Online simulation	3.07	0.51	.29**	.32**	.69**	.85**	.51**	—					
7. Affective empathy	2.88	0.50	.41**	.36**	.83**	.35**	.32**	.29**	—				
8. Emotion contagion	2.88	0.67	.28**	.19*	.56**	.08	.09	.05	.83**	—			
9. Proximal Responsivity	2.99	0.63	.42**	.40**	.77**	.41**	.31**	.41**	.84**	.57**	—		
10. Peripheral Responsivity	2.76	0.55	.28**	.27**	.67**	.38**	.39**	.26**	.72**	.36**	.44**	—	
11. State empathy	3.64	1.15	.37**	.31**	.43**	.42**	.39**	.34**	.28**	.13	.32**	.24**	—

Note. M and *SD* are used to represent mean and standard deviation, respectively.

* $p < .05$; ** $p < .001$.

Table 2.4

Descriptive Statistics and Correlations Among Emotional Face Discrimination (Slope and Threshold) and Empathy (State, Cognitive and Affective) in Study 1 (n = 138)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Angry slope	7.60	5.24	—														
2. Fearful slope	6.51	4.89	.72**	—													
3. Happy slope	8.86	5.43	.70**	.75**	—												
4. Angry threshold	0.25	0.07	.09	-.12	-.11	—											
5. Fearful threshold	0.26	0.07	-.23**	-.13	-.23**	.35**	—										
6. Happy threshold	0.26	0.06	-.23**	-.28**	-.22**	.53**	.63**	—									
7. Empathy total (QCAE)	2.96	0.40	.22**	.09	.24**	.02	-.13	-.07	—								
8. Cognitive empathy	3.05	0.48	.15	.11	.15	.07	-.10	-.06	.81**	—							
9. Perspective taking	3.04	0.58	.12	.05	.05	.11	-.10	-.06	.73**	.88**	—						
10. Online simulation	3.07	0.51	.14	.14	.23**	.01	-.08	-.05	.69**	.85**	.51**	—					
11. Affective empathy	2.88	0.50	.21*	.04	.24**	-.03	-.11	-.05	.83**	.35**	.32**	.29**	—				
12. Emotion contagion	2.88	0.67	.14	.-06	.13	.02	-.02	.05	.56**	.08	.09	.05	.83**	—			
13. Proximal Responsivity	2.99	0.63	.11	-.00	.17*	-.04	-.06	.00	.77**	.41**	.31**	.41**	.84**	.57**	—		
14. Peripheral Responsivity	2.76	0.55	.27**	.18*	.29**	-.06	-.19*	-.19*	.67**	.39**	.39**	.26**	.72**	.36**	.44**	—	
15. State empathy	3.64	1.15	.16	.09	.11	.05	.05	.06	.43**	.42**	.39**	.34**	.28**	.13	.32**	.24**	—

*Note***.** *M* and *SD* are used to represent mean and standard deviation, respectively.

* $p < .05$; **$p < .001$.

Table 2.5

Mediation of the Relation Between Nostalgia Proneness and Sensitivity to the Stimulus Intensity (Threshold) by Empathy in Study 1 (n = 138)

			Effect of IV on M	Effect of M on DV	Total effect	Direct effect	Indirect effect			
IV	M	DV	a	b	c	c’	*ab*	*SE*	95% CI	ab_{fs}
PPS	Cognitive empathy	Angry (Threshold)	0.186**	0.028*	-0.015*	-0.020*	0.005^{T}	0.003	[0.0001, 0.0114]	0.005
	Perspective taking	Angry (Threshold)	0.215**	0.028*	-0.015*	-0.021*	0.006^{T}	0.003	[0.0004, 0.0127]	0.006

Note. PPS, Past Positive Scale; IV, independent variable; DV, dependent variable; M, mediator; *SE*, standard error; CI, confidence interval. *ab*, the indirect effect; ab_{fs}, effect size.

* $p < .05$; ** $p < .001$.

Table 2.6

Mediation of the Relation Between Nostalgia Proneness and the Precision of Responses at Threshold (Slope) by Empathy in Study 1 (n = 138)

			Effect of IV on M	Effect of M on DV	Total effect	Direct effect	Indirect effect			
IV	M	DV	a	b	c	c’	*ab*	*SE*	95% CI	ab_{fs}
SNS	Empathy Total	Happy (Slope)	0.130**	2.769*	0.687*	0.328	0.360^{T}	0.202	[0.0261, 0.8052]	0.359
	Affective Empathy	Happy (Slope)	0.150**	2.216*	0.687*	0.354	0.332^{T}	0.181	[0.0150, 0.7203]	0.333
	Online Simulation	Happy (Slope)	0.112*	2.090*	0.687*	0.453	0.224^{T}	0.144	[0.0002, 0.0814]	0.234
	Peripheral Responsivity	Happy (Slope)	0.115*	2.593*	0.687*	0.388	0.298^{T}	0.166	[0.0054, 0.1017]	0.299
	Peripheral Responsivity	Angry (Slope)	0.115*	2.255*	0.734*	0.474	0.259^{T}	0.126	[0.0563, 0.5455]	0.260
PPS	Empathy Total	Angry (Slope)	0.178**	2.862*	0.536	0.026	0.509^{T}	0.245	[0.0800, 1.0206]	0.510
	Affective Empathy	Angry (Slope)	0.170**	2.108*	0.536	0.178	0.358^{T}	0.184	[0.0361, 0.7550]	0.358
	Peripheral Responsivity	Angry (Slope)	0.143*	2.486*	0.536	0.180	0.355^{T}	0.158	[0.0920, 0.7083]	0.356
	Online Simulation	Happy (Slope)	0.158*	2.064*	0.901*	0.576	0.326^{T}	0.195	[0.0005, 0.7581]	0.326
	Peripheral Responsivity	Happy (Slope)	0.143*	2.588*	0.902*	0.531	0.370^{T}	0.204	[0.0643, 0.8556]	0.371

Note. SNS, Southampton Nostalgia Scale; PPS, Past Positive Scale; IV, independent variable; DV, dependent variable; M, mediator; *SE*, standard error; CI, confidence interval. *ab*, the indirect effect; ab_{fs}, effect size.

* $p < .05$; ** $p < .001$.

Table 2.7

Descriptive Statistics and Correlations Among Trait Nostalgia and Emotional Face Discrimination (Slope and Threshold) in Study 2 (n = 151)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
1. Angry slope	8.79	3.81	—									
2. Fearful slope	7.51	3.27	.56**	—								
3. Happy slope	8.64	3.27	.59**	.66**	—							
4. Angry threshold	0.01	0.13	.35**	.26**	.34**	—						
5. Fearful threshold	0.03	0.05	-.10	.03	-.18*	-.19*	—					
6. Happy threshold	0.01	0.09	.18*	.16	.29**	.16*	-.27**	—				
7. Nostalgia proneness (SNS)	4.69	1.29	-.06	-.12	-.13	-.11	.06	-.14	—			
8. Nostalgia proneness (NPI)	4.65	1.07	-.15	-.11	-.14	-.08	-.06	-.10	.71**	—		
9. Nostalgia Proneness (PPS)	5.12	1.26	-.20*	-.15	-.11	-.11	.04	-.09	.57**	.69**	—	
10. Nostalgia Proneness (Total)	4.80	1.05	-.16	-.15	-.14	-.11	.01	-.12	.86**	.92**	.85**	—

*Note***.** *M* and *SD* are used to represent mean and standard deviation, respectively. SNS, the Southampton Nostalgia Scale; PPS, the Past Positive Scale; NPI, Nostalgia Proneness Index.

* $p < .05$; ** $p < .001$.

Table 2.8

Descriptive Statistics and Correlations Among Trait Nostalgia, Empathy and Attachment Security in Study 2 (n = 151)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Nostalgia Proneness (SNS)	4.69	1.29	—																			
2. Nostalgia Proneness (NPI)	4.65	1.07	.71**	—																		
3. Nostalgia Proneness (PPS)	5.12	1.26	.57**	.69**	—																	
4. Nostalgia Proneness (Total)	4.80	1.05	.86**	.92**	.85**	—																
5. Cognitive Empathy (QCAE)	57.15	8.81	.11	.18*	.21**	.19*	—															
6. Perspective taking (QCAE)	29.85	5.71	.06	.13	.20*	.15	.91**	—														
7. Online simulation (QCAE)	27.29	4.32	.15	.20*	.17*	.20*	.84**	.54**	—													
8. Affective empathy (QCAE)	34.42	5.86	.18*	.24**	.11	.21*	.44**	.34**	.44**	—												
9. Emotion contagion (QCAE)	11.54	2.67	.11	.16*	.13	.15	.32**	.23**	.35**	.82**	—											
10. Proximal Responsivity (QCAE)	11.88	2.31	.13	.19*	.13	.17*	.52**	.41**	.51**	.85**	.64**	—										
11. Peripheral Responsivity (QCAE)	11.00	2.46	.19*	.23**	.01	.17*	.20*	.17*	.19*	.70**	.26**	.39**	—									
12. Total Empathy (QCAE)	91.56	12.53	.16*	.24**	.20*	.23**	.91**	.80**	.80**	.77**	.61**	.76**	.47**	—								

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
13. Fantasy (IRI)	3.29	0.85	.19*	.16	.00	.13	.16	.08	.21**	.62**	.33**	.38**	.75**	.40**	—							
14. Empathic Concern (IRI)	3.80	0.72	.12	.21**	.10	.17*	.49**	.35**	.53**	.64**	.46**	.66**	.40**	.64**	.40**	—						
15. Perspective Taking (IRI)	3.65	0.67	.15	.22**	.16	.20*	.72**	.49**	.82**	.41**	.31**	.48**	.20*	.70**	.21**	.59**	—					
16. Personal Distress (IRI)	2.85	0.79	.05	.09	-.05	.04	-.04	-.08	.03	.39**	.51**	.25**	.14	.16	.24**	.22**	.02	—				
17. Cognitive Empathy (FRT)	0.62	0.09	.08	.04	-.05	.03	.13	.14	.07	.13	.02	06	.22**	.15	.22**	.09	.09	-.02	—			
18. Empathic Accuracy (FRT)	0.55	0.18	-.07	-.18*	-.16*	-.16	.00	.00	.01	.10	-.04	.07	.21*	.05	.20*	.02	-.03	-.06	.56**	—		
19. Affective Empathy (FRT)	0.48	0.20	-.05	-.18	-.03	-.11	-.04	-.01	-.07	.15	.06	.11	.18*	.04	.15	.04	-.03	.06	.41**	.70**	—	
20. Attachment Security (ASQ)	3.80	0.70	.04	.10	.27**	.15	.29**	.26**	.25**	..22**	.10	.36**	.09	.31**	.08	.36**	.22**	-.06	-.17*	-.10	-.01	—

*Note***.** *M* and *SD* are used to represent mean and standard deviation, respectively. SNS, the Southampton Nostalgia Scale; PPS, the Past Positive Scale; NPI, Nostalgia Proneness Index; QCAE, the Questionnaire of Cognitive and Affective Empathy; IRI, the Interpersonal Reactivity Index; FRT, Face Rating Task; ASQ, the Attachment Style Questionnaire.

* $p < .05$; **$p < .001$.

Table 2.9

Descriptive Statistics and Correlations Among Emotional Face Discrimination (Slope and Threshold), Empathy and Attachment Security in Study 2 (n = 151)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. Angry S	8.79	3.81	—																					
2. Fearful S	7.51	3.27	.56**	—																				
3. Happy S	8.64	3.27	.59**	.66**	—																			
4. Angry T	0.01	0.13	.35**	.26**	.34**	—																		
5. Fearful T	0.03	0.05	-.10	.03	-.18*	-.19*	—																	
6. Happy T	0.01	0.09	.18*	.16	.29**	.16*	-.27**	—																
7. CE (QCAE)	57.15	8.81	.02	.05	.03	-.09	.08	.05	—															
8. PT (QCAE)	29.85	5.71	.00	.01	-.01	-.14	.10	.01	.91**	—														
9. OS (QCAE)	27.29	4.32	.05	.10	.08	.01	.04	.09	.84**	.54**	—													
10. AE (QCAE)	34.42	5.86	.10	.11	.06	-.01	.03	.07	.44**	.34**	.44**	—												
11. EC (QCAE)	11.54	2.67	.03	.02	-.03	-.06	.03	.01	.32**	.23**	.35**	.82**	—											
12. ProR (QCAE)	11.88	2.31	.07	.07	.06	.01	.04	.10	.52**	.41**	.51**	.85**	.64**	—										
13. PeriR (QCAE)	11.00	2.46	.14	.16*	.13	.03	.00	.06	.20*	.17*	.19*	.70**	.26**	.39**	—									
14. TE (QCAE)	91.56	12.53	.06	.09	.05	-.07	.07	.07	.91**	.80**	.80**	.77**	.61**	.76**	.47**	—								
15. F (IRI)	3.29	0.85	.10	.14	.13	.04	-.10	.05	.16	.08	.21**	.62**	.33**	.38**	.75**	.40**	—							
16. EC (IRI)	3.80	0.72	.07	.09	.11	.06	.03	-.06	.49**	.35**	.53**	.64**	.46**	.66**	.40**	.64**	.40**	—						

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
17. PT (IRI)	3.65	0.67	.07	.08	.11	.02	.01	-.01	.72**	.49**	.82**	.41**	.31**	.48**	.20*	.70**	.21**	.59**	—					
18. PD (IRI)	2.85	0.79	.00	.06	.01	-.01	-.03	-.03	-.04	-.08	.03	.39**	.51**	.25**	.14	.16	.24**	.22**	.02	—				
19. CE (FRT)	0.62	0.09	.48**	.48**	.44**	.18*	-.19*	.02	.13	.14	.07	.13	.02	.06	.22**	.15	.22**	.09	.09	-.02	—			
20. EA (FRT)	0.55	0.18	.53**	.45**	.46**	.17**	-.19*	.15	.00	.00	.01	.10	-.04	.07	.21*	.05	.20*	.02	-.03	-.06	.56**	—		
21. AE (FRT)	0.48	0.20	.33**	.32**	.32**	.11	-.13	.13	-.04	-.01	-.07	.15	.06	.11	.18*	.04	.15	.04	-.03	.06	.41**	.70**	—	
22. ASQ	3.80	0.70	-.05	-.08	-.02	.02	.10	-.05	.29**	.26**	.25**	.22**	.10	.36**	.09	.31**	.08	.36**	.22**	-.06	-.17*	-.10	-.01	—

*Note***.** *M* and *SD* are used to represent mean and standard deviation, respectively. S, Slope; T, Threshold; CE, Cognitive Empathy; PT, Perspective taking, OS, Online simulation; AE, Affective empathy; EC, Emotion contagion, ProR, Proximal Responsivity; PeriR, Peripheral Responsivity; TE, TotalEmpathy; F, Fantasy; PD, Personal Distress; EA, Empathic Accuracy; QCAE, the Questionnaire of Cognitive and Affective Empathy; IRI, the Interpersonal Reactivity Index; FRT, Face Rating Task; ASQ, the Attachment Style Questionnaire.

* $p < .05$; ** $p < .001$.

Figures

Figure 2.1

Examples of Emotional Expressions

Note. Examples of neutral, angry, fearful and happy stimuli, for male (upper row) and female (lower row) gender.

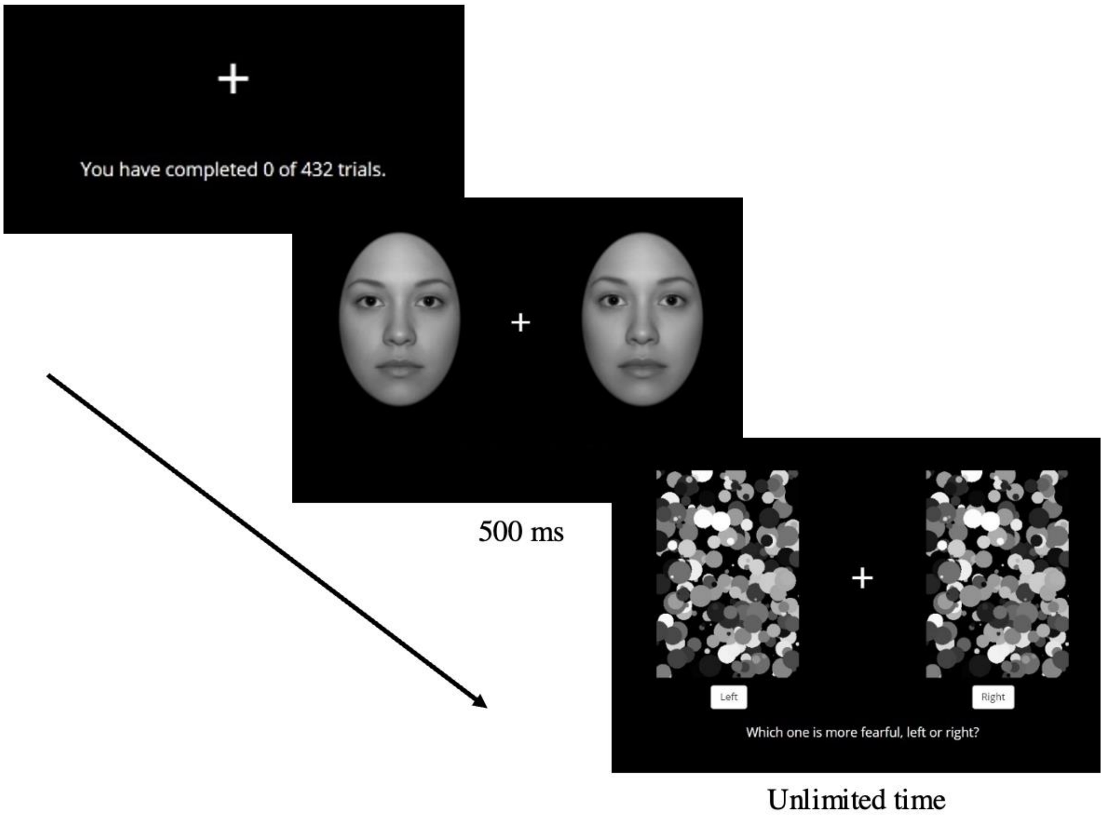
Figure 2.2

Affect Levels

Note. Examples of the nine emotional intensity levels for happy expression across male and female actors, from neutral on the left to full expression on the right.

Figure 2.3

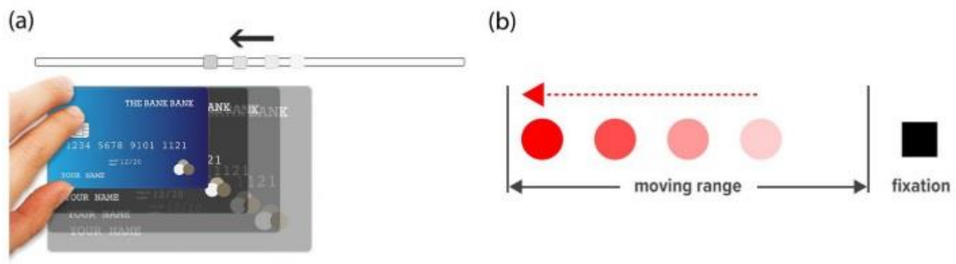
Illustration of the Trial Sequence of the Face Discrimination Task



Note. After clicking the central white fixation cross, two facial expression stimuli (a neutral face presented beside an emotional face for each trial) were viewed for 500 ms, and then participants were instructed to choose which one of the stimuli expressed the emotion more. The present task was also employed in Experiment 2 as Block 2.

Figure 2.4

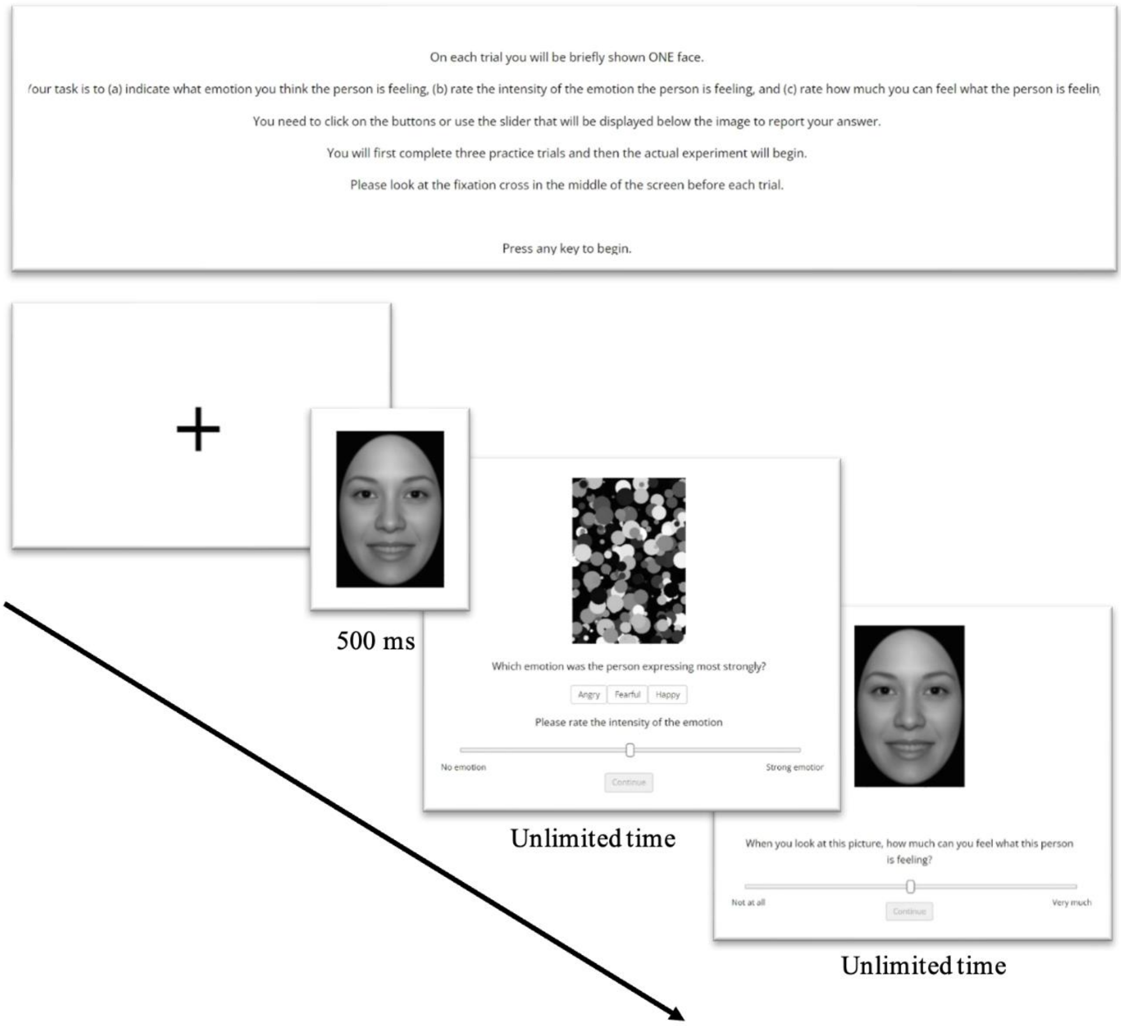
Illustration of the Stimulus Size and Viewing Distance Control



Note. Panel A: Card Task is used to control the stimulus size and the location of the stimuli presented. Participants are instructed to place a real-world card on the screen and move the slider until the size of the image and the card on the screen match. Panel B: The blind Spot Task is used to adjust the viewing distance between participants and the screen. Participants are instructed to fixate on the static black square with their right eye closed as the red dot sweeps repeatedly from right to left, and to press the spacebar when they consider the red dot to have disappeared.

Figure 2.5

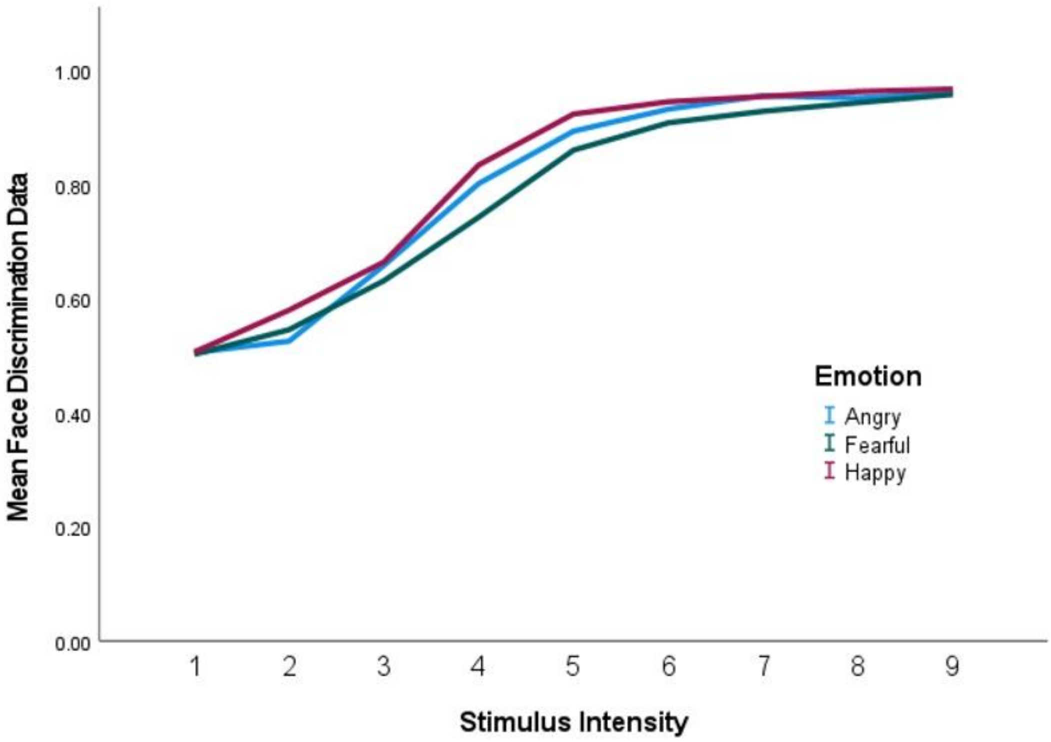
Illustration of the Trial Sequence of the Face Rating Task (Block 1)



Note. After clicking the central black fixation cross, one facial expression stimulus was viewed for 500 ms. Afterwards, participants were instructed to indicate the emotion the person in the image was feeling and rate the intensity of the emotion. Then, they are instructed to rate how much they can feel what the person is feeling.

Figure 2.6

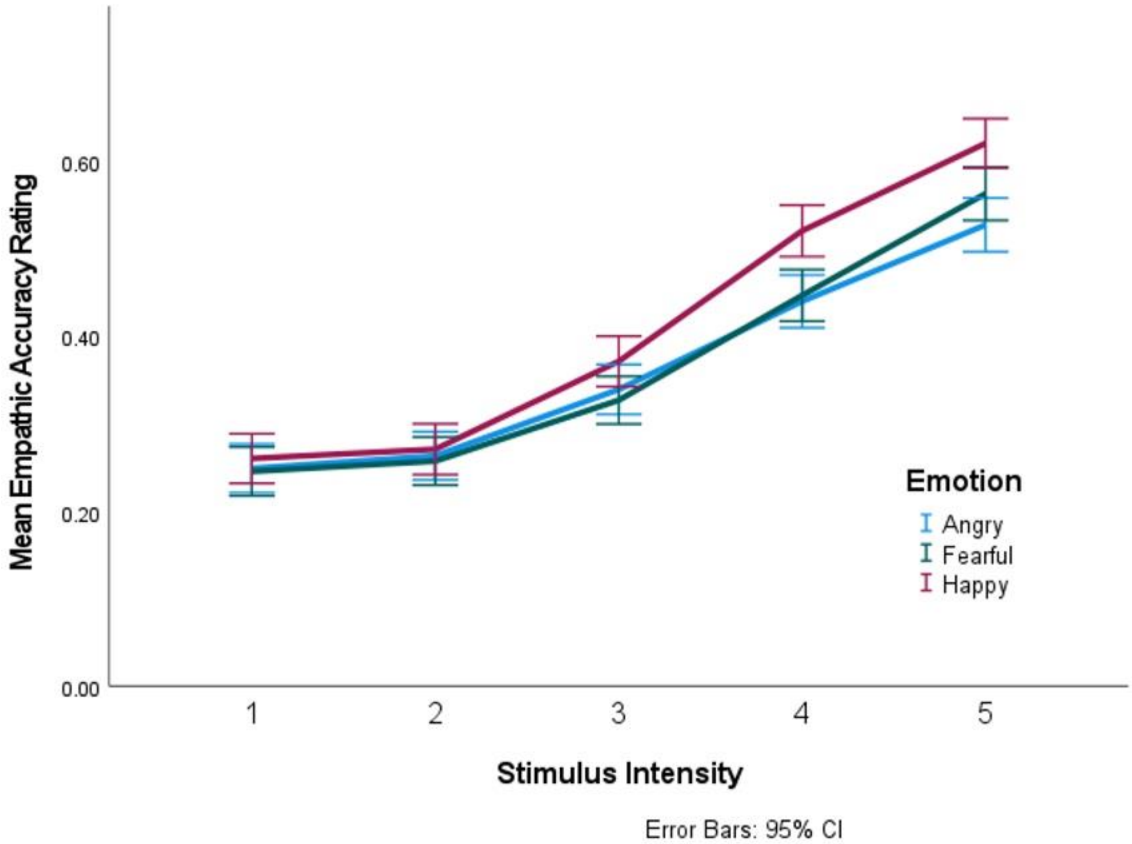
The Summary Graph of the Face Discrimination Task (Block 2 Data)



Note. The summary graph for the proportion of correct responses across emotions at each intensity level for 151 participants.

Figure 2.7

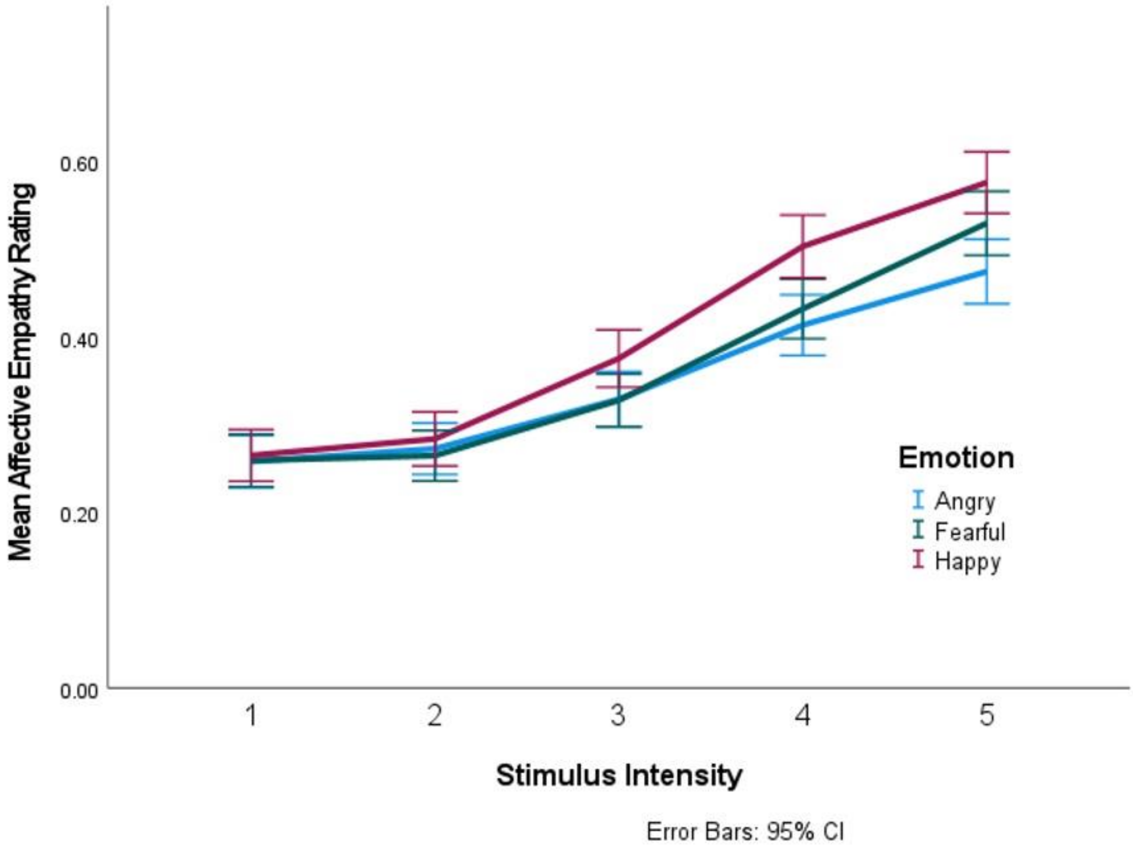
The Summary Graph of the Face Rating Task (Block 1 Data)



Note. The summary graph for the average rating of the participants across emotions at each intensity level for empathic accuracy.

Figure 2.8

The Summary Graph of the Face Rating Task (Block 1 Data)



Note. The summary graph for the average rating of the participants across emotions at each intensity level for affective empathy.

Chapter 3

Empirical Paper II

Virtual Reality and Nostalgia

In the preceding chapter, I observed a diminishing impact on nostalgia induction subsequent to the face categorisation task. This observation led me to consider that the effect may diminish or become negligible when applied in comparatively extended experimental designs. Although several techniques have been developed to induce nostalgia, their inherent limitations prompted my motivation to devise a novel approach. Consequently, my primary objective was to assess the effectiveness of virtual reality (VR) in eliciting nostalgia.

Chapter 3

The Efficacy of a Virtual-Reality Nostalgia Induction

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Abstract

Nostalgia is defined as a sentimental longing or a wistful affection for the past (New Oxford Dictionary of English, 1998). Several validated techniques have been developed and used to induce a nostalgic state experimentally, including the Event Reflection Task (ERT, Sedikides et al., 2015b), visual imagery tasks (Verplanken, 2012), music (Cheung et al., 2013; Evans et al., 2022; Stephan et al., 2015; Zhou et al., 2012), and song lyrics (Cheung et al., 2013). However, the effect of nostalgia induction might decrease or disappear when used in relatively long experimental designs. Based on studies showing that as the intensity of the eliciting stimulus increases, there is a corresponding increase in the intensity of the emotional episode (Schimmack, 2003; Verduyn et al., 2009, Verduyn et al., 2011), we used Virtual Reality (VR) technology to induce an immersive and intense nostalgic experience. We explored whether: (a) VR can be used to induce nostalgia as a novel method; (b) nostalgia manipulation has a stronger effect when it is applied with the Virtual Reality Task (VRT) compared to ERT; and (c) VRT-induced nostalgia will convey psychological benefits. We assigned participants to the experimental conditions in a 2 (nostalgia vs. control) x 2 (VRT vs. ERT) design. After the induction, we measured felt nostalgia (manipulation check) and psychological benefits. Results showed that the VR nostalgia induction was successful. Additionally, self-continuity, social connectedness, and empathy were higher in the nostalgia than in the control condition when nostalgia was induced with VR. However, there was no significant difference between the VRT and ERT methods in terms of the efficacy of the nostalgia induction.

Keywords: nostalgia, emotion induction, virtual reality, virtual environments

The Efficacy of a Virtual-Reality Nostalgia Induction

Nostalgia is a sentimental longing or a wistful affection for the past (New Oxford Dictionary of English, 1998). Nostalgic memories often involve personal experiences, certain periods in life such as childhood, the relation between self and significant others, and momentous events such as holiday gatherings, graduation ceremonies, and anniversaries (Holak & Havlena, 1992; Wildschut et al., 2006). Furthermore, nostalgia is characterised by positive valence, an approach orientation, and low arousal (Van Tilburg et al., 2018). Individuals commonly experience nostalgia when recalling fond memories, even if the recollections evoke feelings of loss or longing. Most people view nostalgia as having positive characteristics (e.g. warm memories, keepsakes) rather than negative ones (e.g. sadness, pain; Hepper et al., 2012).

Psychological Benefits of Nostalgia

Scholars have investigated the potential psychological benefits of nostalgia in controlled laboratory settings, using experimental methods to induce nostalgia. These benefits have been organised into three categories, which are social, self-related, and existential (Sedikides et al., 2004, 2015b; Wildschut & Sedikides, 2022).

Nostalgia conveys social benefit by bolstering social connectedness (i.e. a sense of acceptance and support; Wildschut et al., 2006; Zhou et al., 2008) and encouraging individuals to engage in prosocial behaviour (Stephan et al., 2014; Zhou et al., 2012). In particular, nostalgia fosters perceptions of social support due to its social content, enabling individuals to feel connected to others, trust others, or feel loved (Routledge et al., 2011; Wildschut et al., 2006; Zhou et al., 2008). Increased social connectedness encourages people to empathize with others, engage in prosocial behaviour, and make charitable donations (Juhl et al., 2021; Sedikides et al., 2015a; Zhou et al., 2012).

Given that the self is the main character in nostalgic memories, researchers have also explored the emotion's self-oriented benefits (Sedikides & Wildschut, 2016, 2019;

Wildschut et al., 2006). Wildschut et al. (2006) demonstrated that experimentally induced nostalgia strengthens self-esteem, and increases positive affect. Furthermore, Sedikides et al. (2015b) indicated that nostalgia maintains self-continuity (i.e. a sense of connection between one's past and present self) by acting as a bridge between the past and present.

Finally, nostalgia serves an existential function (Routledge et al., 2011; Sedikides & Wildschut, 2018). In particular, when people engage in nostalgic recollections, they tend to reflect on personally significant experiences, such as personal celebrations, and traditional gatherings which involve significant others. Research has suggested that such recollections fortify the perception of life meaningfulness, and provide a purposeful life (Arndt et al., 2013; Routledge et al., 2011; Wildschut & Sedikides, 2022).

Existing Nostalgia Inductions

Researchers have developed validated techniques to induce nostalgia experimentally, including the Event Reflection Task (ERT; Sedikides et al., 2015b), visual imagery tasks (Verplanken, 2012), music (Barrett et al., 2010; Cheung et al., 2013), and lyrics (Cheung et al., 2013).

Event Reflection Task (ERT). The most common method that is used to evoke nostalgia is the ERT (Sedikides et al., 2015b). In this task, participants are randomly assigned to nostalgic and control conditions. In the nostalgia condition, participants are instructed to recall a nostalgic memory from their past and write keywords related to that memory. After they provide the keywords, they are instructed to write about that nostalgic event for around 5-6 minutes. In the control condition, participants bring to mind an ordinary event that happened in the past, and they write keywords associated with the ordinary event accordingly. One limitation of this method could be the difficulty in distinguishing between nostalgic and ordinary memories; even recalling an ordinary experience from the past may generate nostalgia. Additionally, people may not fully immerse themselves in the nostalgic experience due to the short duration of manipulation.

Music-Evoked Nostalgia. Researchers have used music as a method of nostalgia induction (Sedikides et al., 2022). To illustrate, Cheung et al. (2013, Study 3) assigned participants to a condition where they listened to either nostalgic or control songs. Participants who listened to the nostalgic song expressed greater levels of nostalgia than those who listened to the control song, as intended. Although music inductions have been successfully applied, there are some limitations to consider. For example, it might not be possible to select songs that evoke nostalgia for everyone, because music preference is changeable and personal, and is determined by people's autobiographical experiences (Rentfrow & Gosling, 2003).

Song Lyrics. In addition to music, researchers have also used song lyrics to experimentally induce nostalgia. Cheung et al. (2013, Study 4), for example, manipulated nostalgia by asking participants to read lyrics from songs that were previously labelled as nostalgic by them (vs. control lyrics). The findings indicated that, in comparison with those reading control lyrics, participants reading nostalgic lyrics experienced significantly higher levels of nostalgia.

Visual Imagery Task. The visual imagery task (Verplanken, 2012) was based on the ERT. In the nostalgia condition, participants are instructed to visualise their nostalgic event as vividly as possible and describe the details of: (i) the place, situation or event that makes them feel nostalgic; (ii) things, people, sounds, and smells; and (iii) how it makes them feel. In the ordinary condition, participants are instructed to describe a daily event. A limitation of this approach is that it depends on the participants' capacity for visualisation (Hardy & Callow, 1999).

A New VR Nostalgia Induction?

To summarise, although these methods have been validated, we sought a novel and more effective method to address some of the stated limitations of the existing ones. Moreover, upon examination of meta-analyses pertaining to the induction of emotions, it became apparent that the utilisation of images, facial expressions, and cinematic materials proved to be efficacious elicitors, as highlighted in the studies of Joseph et al. (2020) and Lench et al. (2011). Consequently, I aimed to innovate a novel approach employing virtual reality, incorporating immersive visual stimuli to evoke a heightened sense of nostalgia. Virtual reality (VR) may offer a solution. VR allows people to experience computer-generated simulations of life-like environments via a head-mounted display (Botella et al., 2017; Emmelkamp & Meyerbröker, 2021). VR creates a sense of presence during the experience, that is, it involves our senses, catches our attention, and leads to a feeling of “being there” (Riva et al., 2016; Witmer et al., 2005).

VR has many advantages as an experimental tool, including the ability to create novel complex situations, immersive three-dimensional displays, and greater control for the researcher while observing the unique behaviour of participants in a laboratory environment (Wilson & Soranzo, 2015). Arguably, the drawbacks of the previous generation of VR technology (e.g. costly equipment, the necessity for add-on products, and the necessity for advanced technical skills to operate) have limited its use (Aguinas et al., 2001; Bown et al., 2017; Lindner et al., 2017). However, recent developments in VR technology, as well as gradual improvements in devices, have made VR more accessible and user-friendly, resulting in a rise in VR usage (Hatta et al., 2022; Lindner et al., 2021).

With the rise in the use of such technologies, VR also has been employed in the field of psychology for the assessment, understanding, and treatment of mental health disorders (Freeman et al., 2017). In particular, VR can be beneficial for studies that require evoking diverse emotions, since it can be used to reproduce environments virtually when actual presence is not feasible. Due to its immersive nature, which is supported visually and auditorily, VR is likely to elicit stronger emotional responses (Bown et al., 2017; Newman et al., 2022). Indeed, VR has emerged as an efficient tool for inducing various emotions, such as fear (Morie, 2006), angst (i.e. a feeling of anxiety, dread, or unease;

Morie, 2006), awe (i.e. a strong sense of admiration that is occasionally tinged with dread or surprise; Chirico et al., 2016, 2018), and joy (Serrano et al., 2016). Given that VR has been used successfully to induce emotions, we propose it as a novel method to induce nostalgia.

Present Experiment

We tested the efficacy of VR as a novel nostalgia induction and compared it to the ERT, which is the most frequently used induction to date. We hypothesised that individuals would experience a higher level of nostalgia when nostalgia is induced via VR than ERT. We further examined whether nostalgia would convey greater psychological benefits when induced via VR than ERT.

Method

Participants

To determine the sample size to test the study hypotheses, we conducted an a priori power analysis using G*Power 3.1 (Faul et al., 2007). We found that we needed 136 participants to achieve 80% power for detecting a medium effect size, $f \sim .25$, at a significance criterion of $\alpha = .05$. One hundred and sixty-seven University of Southampton students and staff (63 men, 104 women) completed the experiment ($M_{age} = 27.92$, $SD_{age} = 10.45$, $Range_{age} = 18\text{-}85$ years). Of these, one hundred and twelve took part in exchange for course credits. The remaining fifty-five participants completed the experiment voluntarily. While forty-one per cent of the sample was British, fifty-nine per cent were participants from other nationalities. The experimental protocol was approved by the Ethics Committee of the University of Southampton (Reference: 47153).

Materials and Procedure

VR Stimuli

To develop the VR nostalgia induction, we reviewed the literature on the content of nostalgic memories. This literature demonstrates that nostalgic recollections are often associated with specific periods, such as childhood (Batcho, 1995), special events, such as holiday gatherings (Wildschut et al., 2006), and significant others, such as family members and friends (Holak & Havlena, 1992). In addition, to determine the specific themes for the virtual environments, we used NVivo's word frequency query and created a word cloud based on seven hundred and seventeen nostalgic narratives (Figure 3.1). Based on this, we created virtual environments with "Christmas" (a living room with elaborate Christmas decorations) and "Childhood" (a playground) themes for the VR nostalgia induction.

We generated the VR stimuli using Unity 3.2f.1 game engine (Unity Technologies, 2018) with task-related components that were purchased from the Unity Asset Store (https://assetstore.unity.com). We created a total of four virtual environments, two each for the nostalgia and control conditions. Each environment was presented using an Oculus Rift VR head-mounted display with 1080 × 1200 resolution per eye (Facebook Inc.) running on a Dell computer with an Intel i7 processor (Windows 10 operating system).

Virtual Reality Task (VRT)

For the VRT nostalgia condition, we created a three-dimensional virtual children's playground (Figure 3.2A) and a three-dimensional virtual living room with Christmas decorations (Figure 3.2B). For the VRT control condition, we designed a three-dimensional empty playground (Figure 3.2C) and a three-dimensional empty living room (Figure 3.2D). Participants in the nostalgia condition were instructed to choose one of two nostalgic environments. After donning the VR headset, the experimenter read out the definition of nostalgia and instructed participants to recall a nostalgic memory from their past related to the nostalgic environment that they chose, and then describe the event verbally.

> According to the Oxford Dictionary, ‘nostalgia’ is defined as a ‘sentimental longing for the past’. Please think of a nostalgic event in your life related to the environment that you are experiencing now. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel? For the next 7 to 10 minutes, you will speak about the nostalgic event while looking around the environment. When you are ready, you can start describing your memory and how it makes you feel.

Participants in the control condition were instructed to bring to mind an ordinary past event that happened outside or at home while looking around the empty virtual environments that they chose:

> Please think of an ordinary event in your life related to the environment that you are experiencing now. Specifically, try to recall an ordinary memory from your past that happened outside/at home. Bring this ordinary memory in mind and immerse yourself in the ordinary experience. How does it make you feel? For the next 7 to 10 minutes, you will speak about the ordinary event while looking around the environment. When you are ready, you can start describing your memory and how it makes you feel.

After this stage, the participants recorded four keywords that summarised the memory they recalled during the task.

Event Reflection Task (ERT)

The ERT is a validated nostalgia induction (Sedikides et al., 2015b) which consists of a vivid autobiographical writing task. The original version of the ERT includes instructions that prompt participants to recall a nostalgic or ordinary memory from their past. Participants in the nostalgia condition were given a task that included the definition of nostalgia (“According to the New Oxford Dictionary of English, nostalgia is defined as a sentimental longing for the past"), as well as directions to recall a nostalgic event from their past ("Please think of a nostalgic event in your life. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel?"). Participants in the control condition were asked to recollect an ordinary memory ("Please bring to mind an ordinary event in your life. Specifically, try to think of a past event that is ordinary. Bring this ordinary experience to mind. Immerse yourself in the ordinary experience. How does it make you feel?"). They were first instructed to write keywords describing the nostalgic or ordinary event that they recalled, then were given 7 to 10 minutes to write about that event with vivid and descriptive details, after reading the instructions.

As there are two options for inducing nostalgia within the VR condition (i.e. Christmas room and playground), we slightly modified the original ERT instructions by providing participants with two options, to match the VRT condition. In the nostalgia condition, we added the sentence, "Please think of a nostalgic event in your life related to A) the Christmas Holiday or B) your childhood." In the control condition, we added: "Please bring to mind an ordinary event in your life (i.e. an ordinary event that happened outside or at home)".

Manipulation Check

We administered a manipulation check (Wildschut et al., 2006) after the nostalgia induction (VRT or ERT). The manipulation check includes three items (e.g. "Right now, I am having nostalgic feelings") that were rated on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*; $\alpha = .98$, $M = 4.67$, $SD = 1.82$).

Psychological Benefits of Nostalgia

We assessed the extent to which the nostalgia induction (VRT or ERT) influenced positive affect (e.g. "makes me feel happy"; $\alpha = .86$, $M = 4.27$, $SD = 1.31$), negative affect (e.g. "makes me feel upset"; $\alpha = .83$, $M = 1.93$, $SD = 1.25$), self-esteem (e.g. "makes me value myself more"; α = .92, *M* = 4.03, *SD* = 1.26), self-continuity (e.g. "makes me feel connected with my past"; α = .76, *M* = 4.34, *SD* = 1.40), social connectedness (e.g. "makes me feel connected to loved ones"; α = .90, *M* = 4.20, *SD* = 1.52), and meaning in life (e.g. "makes me feel life has a purpose"; α = .90, *M* = 3.76, *SD* = 1.34). We assessed these outcomes with the 28-item Nostalgia Functions Scale (NFS; Hepper et al., 2012; Routledge et al., 2011; Sedikides et al., 2015b; Wildschut et al., 2010). Items were rated on a 6-point scale (1 = *strongly disagree*, to 6 = *strongly agree*). In addition, we assessed empathy (Batson et al., 1987; Batson et al., 1983) with 12 empathy-related adjectives (e.g., sympathetic, compassionate, soft-hearted, tender, warm, moved). The items were rated on a 6-point scale (1 = *strongly disagree*; 6 = *strongly agree*; α = .94, *M* = 3.92, *SD* = 1.40). We prefaced items with the stem "Thinking about this event…", referring to the event participants had recalled during ERT or VRT.

Procedure

We randomly assigned participants to the experimental conditions: VRT-nostalgia (*n* = 43), VRT-control (*n* = 41), ERT-nostalgia (*n* = 42), and ERT-control (*n* = 41). We instructed participants completing the ERT to write about a nostalgic or an ordinary memory. We instructed participants completing the VRT to wear the VR headset and choose one of the two virtual environments using the remote controller, in accordance with their experimental condition. Following this, they were instructed to speak about a nostalgic or ordinary event related to the virtual scene that they were experiencing. Following the nostalgia induction (VRT or ERT), we instructed participants to type four keywords summarising their nostalgic or ordinary memory, and then to complete the dependent measures that were presented on a computer. The entire procedure lasted approximately 40 minutes and was completed in a laboratory setting, in a single session.

Results

Manipulation Check

To examine the effects of the induction method (VRT vs. ERT) and condition (nostalgia vs. control) on felt nostalgia (manipulation check), we conducted a 2 x 2 between-subjects ANOVA. We present descriptive statistics in Table 3.1. The analysis revealed a significant main effect of nostalgia (vs. control) on felt nostalgia, $F(1,163) = 36.90$, $p < .001$, $\eta_p^2 = .185$. As intended felt nostalgia was significantly higher in the nostalgia than in the control condition. The main effect of the induction method was not significant, $F(1,163) = 0.28$, $p = .598$, $\eta_p^2 = 002$. The interaction between nostalgia and the induction method was not significant, $F(1,163) = 0.01$, $p = .916$, $\eta_p^2 = 000$. The nostalgia manipulation was successful regardless of the induction method. The VRT induced approximately the same level of felt nostalgia as the ERT.

Psychological Benefits

We analysed the benefits of nostalgia in a series of 2 x 2 between-subjects ANOVAs. We present descriptive statistics in Table 3.2.

Positive Affect

Results revealed a significant main effect of nostalgia (vs. control) on positive affect, $F(1,163) = 3.94$, $p = .049$, $\eta_p^2 = .024$. As intended, positive affect was higher in the nostalgia than the control condition. The main effect of induction method was not significant, $F(1,163) = 0.12$, $p = .735$, $\eta_p^2 = .001$, and neither was the interaction, $F(1,163) = 0.50$, $p = .480$, $\eta_p^2 = .003$.

Negative Affect

The main effect of nostalgia (vs. control) on negative affect was not significant, $F(1,163) = 0.17$, $p = .684$, $\eta_p^2 = .001$. There was no significant main effect of induction method, $F(1,163) = 1.42$, $p = .236$, $\eta_p^2 = .009$, and no significant interaction, $F(1,163) = 0.09$, $p = .770$, $\eta_p^2 = 001$.

Self-Esteem

The main effect of nostalgia (vs. control) on self-esteem was not significant, $F(1,163) = 1.03$, $p = .312$, $\eta_p^2 = .006$. The main effect of induction method was significant, $F(1,163) = 5.60$, $p = .019$, $\eta_p^2 = .033$. Self-esteem was higher in the ERT than the VRT condition. The interaction between induction method and nostalgia (vs. control) was not significant, $F(1,163) = 1.69$, $p = .196$, $\eta_p^2 = .010$.

Self-Continuity

The main effect of nostalgia (vs. control) on self-continuity was significant, $F(1,163) = 25.09$, $p < .001$, $\eta_p^2 = .133$. Nostalgia (compared to control) increased self-continuity. The main effect of induction method was not significant, $F(1,163) = 0.02$, $p = .888$, $\eta_p^2 = .000$. The interaction between induction method and nostalgia (vs. control) was not significant, $F(1,163) = 1.73$, $p = .191$, $\eta_p^2 = .010$.

Social Connectedness

The main effect of nostalgia (vs. control) on social connectedness was significant, $F(1,163) = 41.76$, $p < .001$, $\eta_p^2 = .204$. Nostalgia (compared to control) increased social connectedness. The main effect of induction method was not significant, $F(1,163) = 0.05$, $p = .826$, $\eta_p^2 = .000$. The interaction between induction method and nostalgia (vs. control) was not significant, $F(1,163) = 1.78$, $p = .185$, $\eta_p^2 = .011$.

Meaning

The main effect of nostalgia (vs. control) on meaning was significant, $F(1,163) = 6.25$, $p = .013$, $\eta_p^2 = .037$. Nostalgia (compared to control) increased meaning. The main effect of induction method on meaning was not significant, $F(1,163) = 1.43$, $p = .233$, $\eta_p^2 = .009$. The interaction between induction method and nostalgia (vs. control) was significant (Figure 3.3), $F(1,163) = 4.53$, $p = .035$, $\eta_p^2 = .027$. Tests of simple nostalgia effects revealed that nostalgia (compared to control) significantly increased meaning when the emotion was induced with the ERT, $F(1, 163) = 10.64$, $p = .001$, $\eta_p^2 = .061$, but not when it was induced with the VRT, $F(1, 163) = 0.07$, $p = .792$, $\eta_p^2 = .000$.

Empathy

The main effect of nostalgia (vs. control) on empathy was significant, $F(1,163) = 20.14$, $p < .001$, $\eta_p^2 = .110$. Nostalgia (compared to control) increased empathy. The main effect of induction method was not significant, $F(1,163) = 0.52$, $p = .471$, $\eta_p^2 = .003$. The interaction between induction method and nostalgia (vs. control) was not significant, $F(1,163) = 2.07$, $p = .152$, $\eta_p^2 = .013$.

Discussion

We tested the efficacy of VR as a novel nostalgia induction and compared it to the ERT. We hypothesised that individuals would experience a higher level of nostalgia when nostalgia is induced via VRT than ERT. We further examined whether nostalgia would convey greater psychological benefits when induced via VRT than ERT. Our findings demonstrated that, whereas the VR nostalgia induction was not more efficient than the ERT, it successfully induced nostalgia and conveyed a number of psychological benefits (self-continuity, social connectedness, and empathy).

With the exception of meaning in life, the VRT and ERT inductions of nostalgia produced similar psychological benefits (i.e., the interaction effects between the induction method and nostalgia (vs. control) tended to be nonsignificant). A possible explanation is that rather than the induction method, the content and details of the recalled memories may influence the intensity of nostalgic feelings and associated psychological benefits. Overall, results in the VRT condition are in line with past studies, suggesting that nostalgia can be induced successfully with VRT.

Implications

To our knowledge, this research is the first attempt to outline how immersive VR technology has been utilised to evoke nostalgia. The findings also have practical implications. Compared to more traditional nostalgia inductions (Sedikides et al., 2015b; Verplanken, 2012), the use of VR might strengthen the beneficial effects of nostalgia in some cases. For example, inducing nostalgia via VR may be helpful for individuals with aphantasia (Keogh & Pearson, 2018), which is manifested by the lack of the ability to visualise. The reason inducing nostalgia via VR may be helpful for individuals with aphantasia is because it provides them with an opportunity to experience memories and emotions in a way that is not reliant on visual imagery. Since people with aphantasia cannot voluntarily generate visual images in their minds (Monzel et al., 2023), they may have difficulty recalling and reliving past experiences. However, VR can simulate multisensory experiences that evoke memories and emotions without the need for visual imagery. By inducing nostalgia in this way, individuals with aphantasia may be able to better connect with their past and experience a greater sense of emotional engagement and personal meaning. Additionally, based on the key elements of VR (i.e. involvement, immersion, and presence; Kaul et al., 2017; Riva et al., 2016; Witmer et al., 2005; Witmer & Singer, 1998), we have demonstrated that it is possible to create and use intense, life-like replications of typical nostalgic scenes through virtual environments.

Moreover, our findings hold potential clinical significance. The utilisation of virtual reality (VR) for nostalgia induction may offer particular advantages to individuals grappling with challenges in recalling or narrating autobiographical memories, such as those afflicted by Alzheimer's Disease or Dementia (Ismail et al., 2018; Jack et al., 2011). The immersive nature of VR allows for controlled re-experiencing of past events (Lindner et al., 2017; Wilson & Soranzo, 2015). Consequently, employing VR-based nostalgia induction emerges as a potent tool tailored to the unique needs of individuals with these specific conditions, potentially enhancing their psychological well-being.

Limitations and Future Directions

There are a number of limitations to the present research. First, all nostalgia manipulations rely on the idiosyncrasies of the participants (Sedikides et al., 2015b). Our research utilised VR technology and focused on broad nostalgic concepts such as Christmas and childhood. While the Christmas-related scene may not be culturally relevant to all participants, we strive to overcome this issue by providing an alternative option related to their childhood memories. We employed a nomothetic approach using VR by presenting stimuli that were anticipated to elicit nostalgia for most participants in our sample, compared to control stimuli (Dimitriadou et al., 2019; Redhead et al., 2023). We compared this nomothetic VR approach to the idiographic ERT approach, where participants are encouraged to recollect personal memories from their past experiences. Although the nostalgia manipulation with VR alleviated the need for visualisation, it offered participants images that were not specific to their autobiographical memories. Future studies could benefit from adopting an idiographic approach to nostalgia induction, by tailoring the virtual environments to the specific memories and experiences of each participant. This approach may allow for a more personalised and potentially more effective induction of nostalgia.

The second limitation concerns the presence element of VR. Participants' involvement, immersion, and presence in the virtual environment can vary depending on how realistically the virtual environments are presented, distractions, participants' control over the scene, and sensory factors (Witmer & Singer, 1994, 1998). The support of an increased degree of movement perception, scene realism, high digital resolution, sounds, and haptic feedback contribute to a sense of presence and, hence, involvement and immersion (Lamb et al., 2020; Witmer & Singer, 1998). However, the virtual scenes we used were comprised of static, computer-generated images that lacked sensory feedback. Further research could enhance the scenes with a dynamic interactive design to increase the sense of reality, for example by adding animated avatars and scene-appropriate sensory feedback. Additionally, future studies may consider using immersive audio-visual content to recreate real-world environments by employing 360° cameras capable of capturing omnidirectional panoramic images, as demonstrated in previous successful implementations. (Kim et al., 2022; Kim et al., 2020).

Conclusion

We created a successful nostalgia induction using VR. Although the VRT is not more effective than the ERT, this new induction method can be used to elicit nostalgia experimentally in laboratory settings. In addition, we showed that nostalgia induced via VR conveys psychological benefits, including self-continuity, social connectedness, and empathy.

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Tables

Table 3.1

Means And Standard Deviations for the Nostalgia Level Across the Experimental Conditions

	Nostalgia Condition			Control Condition		
	M	*SD*	*n*	*M*	*SD*	*n*
VRT	5.34	1.39	43	3.85	2.01	41
ERT	5.50	1.17	42	3.95	1.79	41

Table 3.2

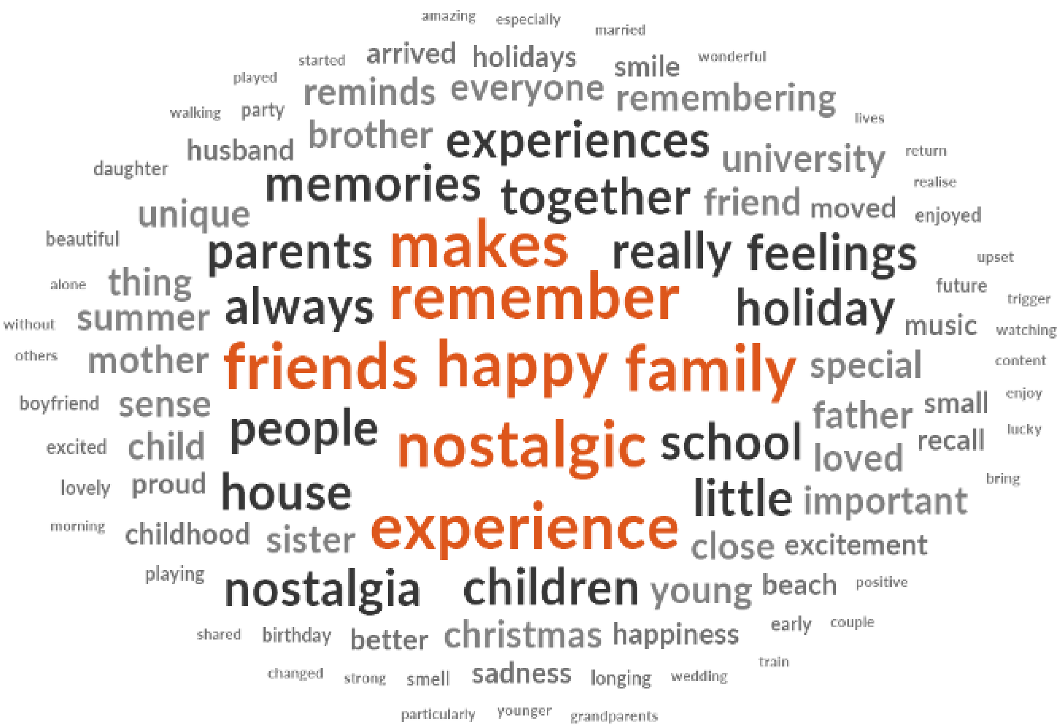
Means And Standard Deviations for the Functions of Nostalgia and Nostalgia-Related State-Empathy Across the Experimental Conditions

Functions of Nostalgia	VRT/Nostalgia $n = 43$		VRT/Control $n = 41$		ERT/Nostalgia $n = 42$		ERT/Control $n = 41$	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Positive Affect	4.34	0.94	4.15	0.98	4.50	0.87	4.09	1.17
Negative Affect	1.97	0.83	2.07	1.15	1.84	0.80	1.85	0.86
Self-esteem	3.63	1.19	4.02	1.01	4.26	1.07	4.21	1.14
Self-continuity	4.63	0.95	4.06	0.90	4.82	0.80	3.84	1.29
Social connectedness	4.65	0.96	3.70	1.48	4.94	0.81	3.49	1.44
Meaning	4.35	1.16	4.28	1.43	4.96	0.87	4.11	1.21
State-empathy	4.20	0.95	3.73	1.18	4.32	0.74	3.39	1.12

Figures

Figure 3.1

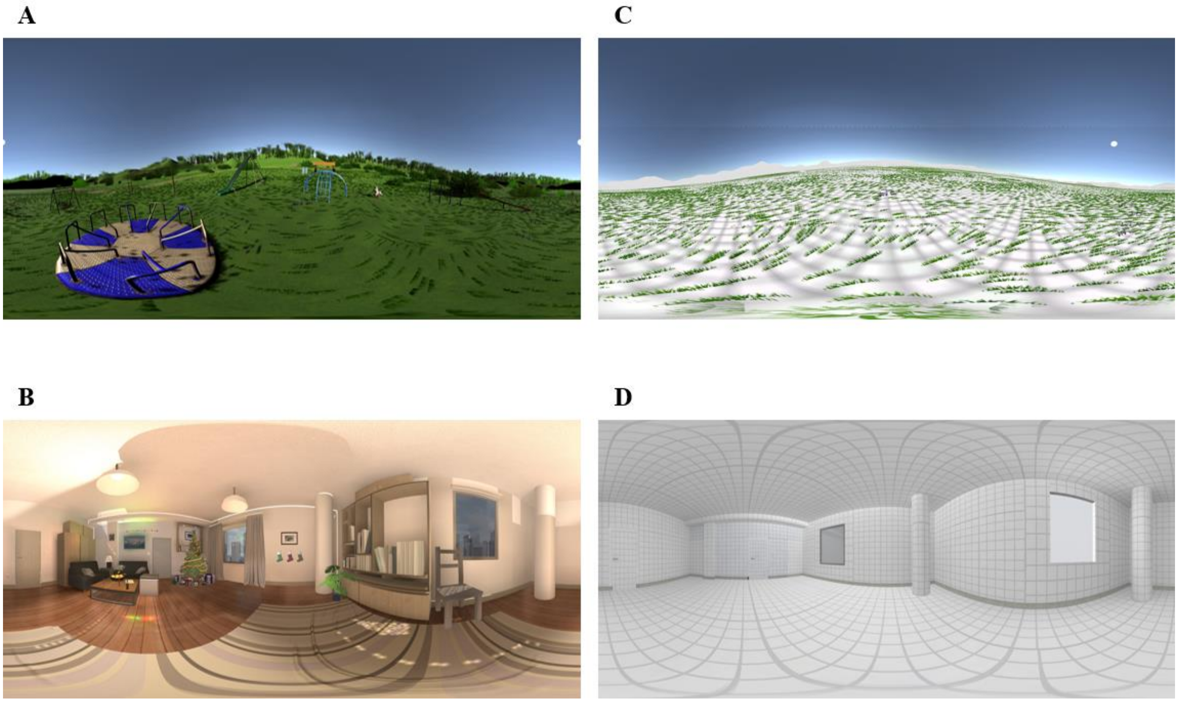
Word Cloud of 717 nostalgic narratives



Note. We excluded the stop words (i.e., less significant words like conjunctions or prepositions that may not be meaningful to the analysis).

Figure 3.2

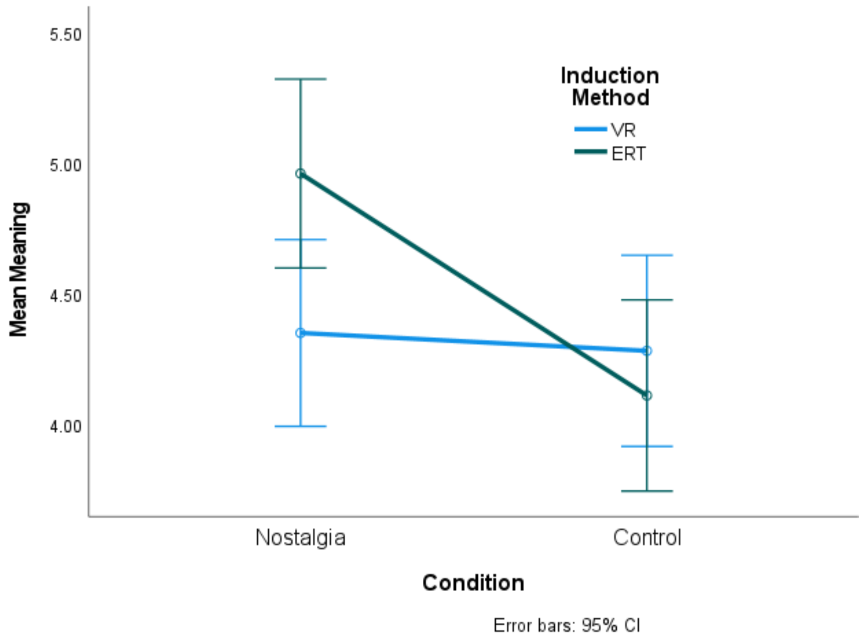
Panoramic Screenshots of Nostalgia and Control Conditions Presented in 360° View Using VR



Note. Panel A: A panoramic screenshot of the nostalgic playground including relevant objects such as a swing, slide, and seesaw. Panel B: A panoramic screenshot of the nostalgic Christmas scene including relevant objects such as a Christmas tree, packed gifts, and Christmas stockings. Panel C: A panoramic screenshot of the empty playground for the control condition. Panel D: A panoramic screenshot of the empty room for the control condition.

Figure 3.3

The Induction Method x Nostalgia (vs. Control) Interaction Effect on Meaning



Chapter 4

Empirical Paper III

Temporal Variability of Nostalgia and Related Functions

In Chapter 3, I found that VR was an effective method for inducing nostalgia. This prompted me to consider whether immersive virtual reality induction leads to prolonged nostalgic feelings. Additionally, I observed that the duration of nostalgic experiences and the changes in their intensity over time have been underexplored. Consequently, my objective was to investigate the temporal variability of nostalgia and the influence of VR on extending nostalgic experiences and their associated benefits.

Chapter 4

Duration of Experimentally Induced Nostalgia and Its Psychological Benefits

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Abstract

Nostalgia, a sentimental longing for the past, can be induced with various techniques. The Event Reflection Task (ERT) is the most frequently used nostalgia induction and instructs participants to bring to mind a nostalgic event (or, in the control condition, an ordinary event) from their personal past. However, the durability of experimentally induced nostalgia and its psychological benefits is unexplored. In a preliminary investigation and two experiments, we explored the duration of nostalgia and its psychological benefits within an experimental context. Experiment 1 was an online ERT experiment in which participants first underwent a nostalgia induction and then completed measures of felt nostalgia (i.e., a manipulation check) and psychological benefits (i.e., positive affect, self-esteem, self-continuity, social connectedness, meaning, empathy) five times over a 20-minute period, with a filler task during intervals. Results revealed that felt nostalgia and psychological benefits were generally higher in the nostalgia than control condition. The magnitude of these nostalgia effects tended to decrease linearly over time but remained statistically significant throughout the 20-minute period for self-continuity, social connectedness, and empathy. Experiment 2 replicated and extended Experiment 1 by examining the efficacy of a novel nostalgia induction based on virtual reality (VR) and comparing it to the ERT. Overall, the results replicated Experiment 1 findings. Under both induction methods (ERT and VR), felt nostalgia and psychological benefits were generally higher in the nostalgia than the control condition, with these nostalgia effects decreasing linearly over time but remaining statistically significant throughout for self-continuity, social connectedness, and empathy.

Keywords: nostalgia, emotion induction, emotion duration, virtual reality

Duration of Experimentally Induced Nostalgia and Its Psychological Functions

To describe emotions fully, one has to consider their dynamic nature (Hemenover, 2003; Kuppens & Verduyn, 2017; Verduyn et al., 2009). This involves investigating the patterns and regularities emotions take as they unfold over time, as well as the underlying mechanisms and aftereffects (Kuppens & Verduyn, 2017). The duration of nostalgic experiences (i.e. sentimental or wistful affection for one's past) and the changes in their intensity over time are underexplored. In the present study, therefore, we examined the temporal profile of nostalgia and its psychological benefits.

Emotion Dynamics

Emotions are complex dynamic states that fluctuate over time (Houben et al., 2015; Verduyn et al., 2009). They are considered evolutionary reactions that facilitate social interactions, acting as crucial indicators for shifts in our surroundings and propelling us to adjust and confront these alterations (Darwin, 1872/1965; Kuppens, 2015). Due to the intricate and dynamic nature of emotions, there is no unanimous agreement among researchers regarding a singular structure. Instead, they present diverse interpretations, utilising categories, dimensions, bipolar or unipolar concepts, simple structures, and circumplex models of emotion based on their individual perspectives (Russell & Feldman Barrett, 1999; Russell, 1980; Watson, 2000). Emotions can last from only a few seconds to several hours or longer (Gilboa & Revelle, 1994; Scherer & Wallbott, 1994; Verduyn et al., 2009; Verduyn et al., 2012). Despite duration being a fundamental aspect of emotions (Kuppens & Verduyn, 2017; Van Mechelen et al., 2013), this has long remained an underexplored area within emotion research. The relatively few pertinent studies have shown that emotion duration is multiply determined, including by factors such as the emotion-triggering stimulus, predispositions of the person experiencing the emotion, and characteristics of the experienced emotion (Frijda, 2007; Moors et al., 2013; Verduyn et al., 2011; Verduyn et al., 2015).

Using data from a series of cross-cultural questionnaire studies, Scherer and Wallbott (1994) examined the universality and cultural variability of seven major emotions (i.e. joy, fear, anger, sadness, disgust, shame, and guilt). The questionnaire asked participants to recall recent situations in which they experienced the seven emotions, and to report the duration (a few minutes, an hour, several hours, or a day or more) and intensity (not very, moderately, intense, or very intense) of the given emotion. Results indicated that fear was the most short-lived emotion and sadness the most enduring. Further, shame was rated as the least intense emotion, with joy and sadness being the most intense. In a related study, Verduyn et al. (2011) instructed participants to estimate the duration of recent anger, sadness, joy, and gratitude episodes, as well as the importance and intensity of the triggering event. Like Scherer and Wallbott, they found that emotional experiences vary greatly in duration. Specifically, gratitude episodes were shorter than episodes of anger, joy, and sadness. Results further revealed that the duration of emotional episodes was positively correlated with the importance and intensity of the eliciting stimulus. The latter result is consistent with findings by Sonnemans and Frijda (1995). They instructed participants to report an emotion each week and rate its intensity, for a total of six weeks. When intensity was higher at the onset of emotion, the emotion lasted longer. The positive relation between emotion duration and intensity of the eliciting stimulus can range from low (Sonnemans & Frijda, 1994) to high (Schimmack, 2003).

Nostalgia

Nostalgia ("a sentimental longing or a wistful affection for the past"; New Oxford Dictionary of English, 1998) is a frequently felt (Batcho, 2013; Wildschut et al., 2006), bittersweet (Leunissen et al., 2021; Wildschut et al., 2006), but predominantly positive (Leunissen, 2023) emotion. Scholars consider nostalgia to be a universal, past-oriented, social, self-relevant, and low-arousal emotion (Baldwin et al., 2015; Hepper et al., 2014; Van Tilburg et al., 2018, 2019).

Nostalgia conveys a number of key psychological benefits (Routledge et al., 2013; Sedikides et al., 2008), which have been broadly classified as self-oriented, social, and existential (Sedikides et al., 2004; Wildschut and Sedikides, 2020). Regarding self-related benefits, as nostalgia can pertain to past accomplishments (e.g., professional, academic, and sporting achievements), the emotion boosts self-positivity (Holak & Havlena, 1992; Vess et al., 2012). Regarding sociality, as nostalgia frequently revolves around social relationships (e.g., parents, children), the emotion bolsters social connectedness, perceived social support, and empathy (Sedikides & Wildschut, 2019). Regarding existential benefits, as nostalgic memories frequently centre on personally meaningful and momentous experiences (e.g., weddings, anniversaries), they imbue life with meaning and strengthen self-continuity (i.e., a sense of connection between one's past and present self; Sedikides & Wildschut, 2018).

Researchers have examined these benefits of nostalgia through laboratory experiments. To this end, various techniques to induce nostalgia have been developed, including the event reflection task (ERT; Wildschut et al., 2006), inductions based on music and song lyrics (Cheung et al., 2013), visual imagery tasks (Verplanken, 2012), and inductions using evocative sensory triggers, such as scents (Reid et al., 2015) and food (Reid et al., 2022). Within this assemblage of techniques, the ERT is the most frequently used procedure for inducing nostalgia. In the nostalgia condition, participants are given a definition of nostalgia and instructed to bring to mind a nostalgic memory from their personal past. They are then prompted to generate keywords that capture the gist of the memory and instructed to write about the nostalgic event for a few minutes. Participants in the control condition are instructed to recall an ordinary event from their personal past, list keywords that capture the event, and write about the event (for details, see Sedikides et al, 2015).

Researchers have used the above-described techniques, particularly the ERT, to investigate brief, transitory episodes of nostalgia. However, there is a dearth of evidence pertaining to the time course of nostalgic episodes and their attendant psychological benefits. Our first objective was to address this lacuna. Our second, related objective was to examine if nostalgia and its psychological benefits can be prolonged with a vivid induction based on virtual reality (compared to the ERT).

Virtual Reality (VR) and Emotion Duration

Emotion intensity at onset is linked to emotion duration, and the eliciting stimulus plays a crucial role in determining emotion intensity (Schimmack, 2003; Sonnemans & Frijda, 1995; Verduyn et al., 2011). We, therefore, sought to develop a novel induction that could enhance nostalgia intensity at the onset and, hence, prolong its duration. We identified virtual reality (VR) as a promising tool for evoking intense nostalgic feelings. VR generates three-dimensional, true-to-life virtual environments, which are viewed via a head-mounted display (Emmelkamp & Meyerbröker, 2021; Serrano et al., 2013). VR enables immersive experiences in a secure laboratory setting, simulations of complex situations, and experimental control (Diemer et al., 2015; Diniz Bernardo et al., 2021; Freeman et al., 2017; Riva et al., 2019).[3]

Involvement (i.e. one's ability to focus on the stimuli that are presented via VR), immersion (i.e. being engaged in the experience emotionally and mentally), and presence (i.e. a feeling of "being there") are among the key elements of a VR system (Riva et al., 2016; Sherman & Craig, 2018; Witmer & Singer, 1998). These features make VR a

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[3] Despite its important benefits, VR also has limitations. To create realistic and immersive environments, VR may require costly equipment, technical knowledge, add-on products, and dedicated software (Bown et al., 2017; Lindner et al., 2017; Newman et al., 2022). Additionally, depending on the equipment and stimuli used, realism may remain low (Marín-Morales et al., 2020). Fortunately, VR has become more accessible and user-friendly as a result of continuous improvements, such as the availability of enhanced high-resolution graphic units, ready-to-use virtual environments/items, and affordable headsets (Berni & Borgianni, 2020; Lindner et al., 2021).

valuable tool for emotion elicitation (Diniz Bernardo et al., 2021; Felnhofer et al., 2015; Rivu et al., 2021). Felnhofer et al. (2015), for example, placed participants in emotionally charged virtual environments and then measured their emotional states (i.e., joy, anger, boredom, anxiety, and sadness). Results indicated that virtual environments successfully elicited joy, anger, boredom, and anxiety. Other studies have successfully used VR to induce awe (Chirico et al., 2018), fear (Thomson et al., 2019), and angst (Morie, 2006).

Considering its key benefits of involvement, immersion, and presence, we anticipated that VR could create rich, life-like replications of nostalgic scenes and stimuli. Accordingly, we hypothesized that VR would enable users to relive and experience past events and places more vividly and intensely, prolonging their nostalgic feelings and attendant psychological benefits (compared to ERT).

Overview

We conducted two experiments to explore the duration of experimentally induced nostalgia and its psychological benefits. We defined duration as the time between the onset and end points of an emotional episode (Frijda et al., 1991; Sonnemans & Frijda, 1994). In Experiment 1, we induced nostalgia with the ERT (Sedikides et al., 2015). We assessed felt nostalgia (i.e. a manipulation check) and its psychological benefits at five-time points throughout the experiment. In Experiment 2, we replicated and extended Experiment 1 by introducing an additional nostalgia induction using VR. The key objective of this experiment was to compare the ERT and VR inductions in terms of their capacity to produce and prolong felt nostalgia and its psychological benefits.

Preliminary Investigation

Prior to conducting Experiments 1 and 2, we carried out a preliminary investigation to examine changes in nostalgia over time. We induced nostalgia with the ERT (Sedikides et al., 2015) and then assessed felt nostalgia three times, and its psychological benefits twice, over a 30-minute period.

Method

Participants

One hundred and sixty-two participants (71 men, 90 women, 1 preferred not to say) completed the experiment online (M_{age} = 25.65 years, SD_{age} = 8.49, $Range_{\text{age}}$ = 18-64). Fifty-six per cent of participants stated that their first language is English. We recruited the participants in exchange for £5 (per hour) from Prolific.co, a widely used and well-regarded platform for connecting researchers and participants (Eyal et al., 2021). All participants gave informed online consent. The experimental protocol was approved by the Ethics Committee of the University of Southampton (Reference: 47153.A2).

Materials and Procedure

ERT

We experimentally manipulated nostalgia with the ERT (Sedikides et al., 2015). We randomly assigned participants to either the nostalgia condition (*n* = 82) or the ordinary-event control condition (*n* = 80). We presented participants in the nostalgia condition with a definition of nostalgia ("according to the New Oxford Dictionary of English, nostalgia is defined as 'a sentimental longing for the past'") and then instructed them to bring to mind a nostalgic event from their past. These instructions read:

> Please think of a nostalgic event in your life. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel?

We instructed participants in the ordinary-event control condition to recall an ordinary event from their past, as follows:

> Please bring to mind an ordinary event in your life. Specifically, try to think of a past event that is ordinary. Bring this ordinary experience to mind. Immerse yourself in the ordinary experience. How does it make you feel?

After recalling the pertinent event, participants listed keywords describing the event and wrote a brief (5-minute) narrative account of their experience.

Time 1 Measures

Immediately following the ERT, participants completed the following assessments. First, we assessed felt nostalgia (i.e. the manipulation check) with three items (e.g. "Right now, I am having nostalgic feelings"; Wildschut et al., 2006) that were rated on a 7-point scale (1 = *strongly disagree*; 7 = *strongly agree*; Time 1: $\alpha = .97$, $M = 4.87$, $SD = 1.78$).

Second, we assessed the psychological benefits of nostalgia (Wildschut et al., 2010; Routledge et al., 2011; Hepper et al., 2012; Sedikides et al., 2015). Specifically, we assessed positive affect (6 items; e.g., "happy"), negative affect (6 items; e.g., "sad"), self-esteem (4 items; e.g., "feel good about myself"), social connectedness (4 items; e.g., "connected to loved ones"), empathy (12 items; e.g., "compassionate"; Batson et al., 1987), meaning (4 items; e.g., "life is meaningful"), and self-continuity (4 items; e.g., "connected with who I was in the past"), Items were rated on a 6-point scale (1 = *strongly disagree*, 6 = *strongly agree*). Each item was preceded by the stem "Thinking about this event makes me feel ...". We present descriptive statistics (means and standard deviations) and reliabilities for Time 1 measures in Table 4.1.

Time 2 Measure

After completing Time 1 measures, which took participants approximately five to seven minutes, they completed the measure of felt nostalgia a second time (Time 2: $\alpha = .98$, $M = 3.75$, $SD = 1.75$). Following this second assessment of felt nostalgia, participants completed a 15-minute filler task to bridge the interval between Time 2 and Time 3. The filler task included 25 items, including anagrams (e.g., "Identify the anagram: 'Pairs' - Which city could it be?"), attentional tasks (e.g., "Describe the stages of planting a seed"), and basic mathematical problems (e.g., "(2 + 3) + 118 = ?").

Time 3 Measures

After finishing the filler task, participants completed the measure of felt nostalgia a third time (Time 3: $\alpha = .98$, $M = 2.84$, $SD = 1.72$). Next, we assessed psychological benefits (i.e., positive affect, negative affect, self-esteem, social connectedness, empathy, meaning, self-continuity) a second time. We present descriptive statistics (means and standard deviations) and reliabilities for these Time 3 measures in Table 4.1. Finally, participants provided demographic information and were fully debriefed about the purpose of the experiment.[4]

Results

Felt Nostalgia

We present descriptive statistics for felt nostalgia across time points in Table 4.2. To examine the effect of the nostalgia manipulation on felt nostalgia and its change over time, we conducted a 3 (timepoint: Time 1, Time 2, Time 3) x 2 (condition: nostalgia, control) mixed Analysis of Variance (ANOVA), with timepoint as a within-subjects variable and condition as a between-subjects variable.[5] The analysis revealed a significant main effect of condition on felt nostalgia, $F(1, 160) = 9.52$, $p = .002$, $\eta_p^2 = .056$. As intended, felt nostalgia was significantly higher in the nostalgia than control condition. The main effect of time on felt nostalgia was also significant, $F(1.75, 280.34) = 101.99$, $p < .001$, $\eta_p^2 = .389$. Across conditions, felt nostalgia decreased from Time 1 ($M = 4.87$, SD

[4] We collected additional measurements for exploratory purposes (administered at a single time): a 28-item Interpersonal Reactivity Index (IRI; Davis, 1980); a 20-item the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988); a 29-item Immersive Tendency Questionnaire (ITQ; Witmer & Singer, 1998); a 7-item Southampton Nostalgia Scale (SNS; Routledge et al., 2008); a 10-item Nostalgia Prototype Scale (NPS; Cheung, et al., 2017); a 4-item Personal Inventory of Nostalgic Experiences (PINE; Newman et al., 2020). Results regarding these measurements will not be presented.

[5] In preliminary investigation and Experiments 1-2, we used Mauchly's test to evaluate the assumption of sphericity. When the assumption was violated, we adjusted degrees of freedom using the Huynh-Feldt correction or Greenhouse Geisser. Specifically, we applied the Huynh-Feldt correction when $\varepsilon > 0.75$ and the Greenhouse-Geisser correction when $\varepsilon < 0.75$.

= 1.74) to Time 2 (M = 3.75, SD = 1.71) to Time 3 (M = 2.84, SD = 1.69). The negative linear trend across timepoints was significant, $F(1, 160) = 145.67$, $p < .001$, $\eta_p^2 = .477$.

The interaction between condition and time was significant (Figure 4.1), $F(1.75, 280.34) = 20.70$, $p < .001$, $\eta_p^2 = .115$. Felt nostalgia was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 160] = 39.56$, $p < .001$, $\eta_p^2 = .198$), and at Time 2 ($F[1, 160] = 5.06$, $p = .026$, $\eta_p^2 = .031$), but not at Time 3 ($F[1, 160] = 1.11$, $p = .293$, $\eta_p^2 = .007$). The interaction between the condition and the linear trend was significant, $F(1, 160) = 29.66$, $p < .001$, $\eta_p^2 = .156$. The negative linear trend across time points in the nostalgia condition was significant, $F(1, 81) = 165.004$, $p < .001$, $\eta_p^2 = .671$. The negative linear trend across time points in the control condition was smaller but also significant, $F(1, 79) = 17.45$, $p < .001$, $\eta_p^2 = .181$.

Psychological Benefits

We present descriptive statistics for psychological benefits across time points in Table 4.3. To examine the effect of nostalgia manipulation on psychological benefits and their change over time, we conducted a 2 (timepoint: Time 1, Time 3) x 2 (condition: nostalgia, control) mixed Analysis of Variance (ANOVA), with timepoint as within-subjects variable and condition as a between-subjects variable.

Positive Affect

The main effect of nostalgia (vs. control) on positive affect was not significant, $F(1, 160) = 0.98$, $p = .324$, $\eta_p^2 = .006$. The main effect of time on positive affect was significant, $F(1, 160) = 14.40$, $p < .001$, $\eta_p^2 = .083$. Across conditions, positive affect decreased from Time 1 (M = 4.02, SD = 1.13) to Time 3 (M = 3.74, SD = 1.14). The interaction between condition and time was not significant, $F(1, 160) = 1.59$, $p = .209$, $\eta_p^2 = .010$.

Negative Affect

The main effect of nostalgia (vs. control) on negative affect was not significant, $F(1, 160) = 0.72$, $p = .397$, $\eta_p^2 = .004$, nor was the main effect of time, $F(1, 160) = 0.12$, $p = .728$, $\eta_p^2 = .001$, or the interaction effect, $F(1, 160) = 0.28$, $p = .595$, $\eta_p^2 = .002$.

Self-Esteem

The main effect of nostalgia (vs. control) on self-esteem was not significant, $F(1, 160) = 0.19$, $p = .664$, $\eta_p^2 = .001$, nor was the main effect of time, $F(1, 160) = 2.02$, $p = .157$, $\eta_p^2 = .012$, or the interaction effect, $F(1, 160) = 0.03$, $p = .872$, $\eta_p^2 = .000$.

Social Connectedness

The main effect of nostalgia (vs. control) on social connectedness was significant, $F(1, 160) = 14.11$, $p < .001$, $\eta_p^2 = .081$. Social connectedness was higher in the nostalgia than control condition. The main effect of time on social connectedness was also significant, $F(1, 160) = 17.38$, $p < .001$, $\eta_p^2 = .098$. Across conditions, social connectedness decreased from Time 1 ($M = 3.86$, $SD = 1.53$) to Time 3 ($M = 3.55$, $SD = 1.47$). The interaction between condition and time was significant as well (Figure 4.2A), $F(1, 160) = 4.32$, $p = .039$, $\eta_p^2 = .026$. Social connectedness was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 160] = 17.56$, $p < .001$, $\eta_p^2 = .099$). The effect of nostalgia was smaller at Time 3 but remained significant ($F[1, 160] = 8.46$, $p = .004$, $\eta_p^2 = .050$).

Empathy

The main effect of nostalgia (vs. control) on empathy was not significant, $F(1, 160) = 2.67$, $p = .104$, $\eta_p^2 = .016$. The main effect of time on empathy was significant, $F(1, 160) = 6.34$, $p = .013$, $\eta_p^2 = .038$. Across conditions, empathy decreased from Time 1 ($M = 3.71$, $SD = 1.21$) to Time 3 ($M = 3.57$, $SD = 1.24$). The interaction between time and nostalgia (vs. control) was significant as well (Figure 4.2B), $F(1, 160) = 8.91$, $p = .003$, $\eta_p^2 = .053$. Empathy was significantly higher in the nostalgia than control condition at Time 1 (F[1, 160] = 6.02, p = .015, η_p^2 = .036). The difference was smaller and not significant at Time 3 (F[1, 160] = 0.52, p = .474, η_p^2 = .003).

Meaning

The main effect of nostalgia (vs. control) on meaning was not significant, F(1, 160) = 3.05, p = .082, η_p^2 = .019. The main effect of time on meaning was significant, F(1, 160) = 12.94, p < .001, η_p^2 = .075. Across conditions, meaning decreased from Time 1 (M = 4.06, SD = 1.45) to Time 3 (M = 3.81, SD = 1.47). The interaction between time and nostalgia (vs. control) was trending, F(1, 160) = 2.96, p = .087, η_p^2 = .018. Meaning was significantly higher in the nostalgia than control condition at Time 1 (F[1, 160] = 4.92, p = .028, η_p^2 = .030), but not at Time 3 (F[1, 160] = 1.26, p = .264, η_p^2 = .008).

Self-Continuity

The main effect of nostalgia (vs. control) on self-continuity was significant, F(1, 160) = 20.36, p < .001, η_p^2 = .113. Self-continuity was higher in the nostalgia than the control condition. The main effect of time on self-continuity was significant, F(1, 160) = 15.18, p < .001, η_p^2 = .087. Across conditions, self-continuity decreased from Time 1 (M = 4.10, SD = 1.11) to Time 3 (M = 3.80, SD = 1.27). The interaction between time and nostalgia (vs. control) was not significant, F(1, 160) = 2.70, p = .103, η_p^2 = .017.

Discussion

The preliminary investigation revealed that the ERT manipulation increased felt nostalgia for approximately five to seven minutes. After the 15-minute filler task, however, the nostalgia and control condition no longer differed on felt nostalgia. Results also highlighted the temporal change in nostalgia's psychological benefits. Whereas the social connectedness and self-continuity benefits of nostalgia were still evident at Time 3, the beneficial effect of nostalgia on empathy was significant at Time 1 only. Nostalgia (compared to control) did not influence positive affect, negative affect, self-esteem, or meaning at either time point.

These preliminary results require replication and extension to address two limitations. First, we assessed felt nostalgia at three time points but the benefits of nostalgia at only two time points. Second, whereas the interval between Time 2 and Time 3 was set as 15 minutes, the interval between Time 1 and Time 2 was not measured precisely and varied depending on the time it took participants to complete Time 1 measures. We sought to address these issues in Experiment 1.

Experiment 1

Experiment 1 was identical to the preliminary investigation. The only exception was that we measured felt nostalgia and psychological benefits five times, with equally spaced intervals.

Method

Participants

To determine the sample size to test the study hypotheses, we conducted an a priori power analysis using G*Power 3.1 (Faul et al., 2007). We found that we needed 98 participants to achieve 80% power for detecting a medium effect size, $f \sim .25$, at a significance criterion of $\alpha = .05$. We recruited one hundred and thirty-six participants (50 men, 83 women, 2 other, 1 preferred not to say) to complete the experiment online (M_{age} = 37.39 years, SD_{age} = 13.65, $Range_{\text{age}}$ = 18-80). Ninety-one per cent of participants stated that their first language is English. We recruited participants from Prolific.co in exchange for £5 (per hour). All participants gave informed online consent before participating in the experiment. The experimental protocol was approved by the Ethics Committee of the University of Southampton (Reference: 47153.A3).

Materials and Procedure

The procedure and materials were identical to the preliminary investigation. The only exception was that we assessed felt nostalgia and psychological benefits five times, with equally spaced intervals. Specifically, we used a filler task to bridge the four 5-minute intervals between time points. To enable precise timing between measurements, we wrote a JavaScript code and integrated it with Qualtrics. This code directed participants to a separate Qualtrics webpage every five minutes to complete assessments related to felt nostalgia and psychological benefits. Upon completing the questionnaires, participants were promptly redirected back to the filler task. The filler task comprised 37 items, including anagrams (e.g., "Identify the anagram: 'Salad Lover' - Which city could it be?"), attentional tasks (e.g., "Describe the stages of cooking pasta"), basic mathematical problems (e.g., "200 – (96 / 4) = ?"), and multiple-choice questions (e.g., "Which is a synonym of 'Empirical'? – 'Debatable,' 'Friendly,' 'Provable,' 'Murky'"). We presented filler items in a randomised order.

We induced nostalgia with the ERT and randomly assigned participants to the nostalgia (n = 68) and control (n = 68) conditions. Next, we assessed felt nostalgia and psychological benefits (i.e., positive affect, negative affect, self-esteem, social connectedness, empathy, meaning, self-continuity) at five timepoints, using the same items as in the preliminary investigation. We present descriptive statistics and reliabilities in Table 4.4. After the final assessment, participants provided demographic information and were fully debriefed about the purpose of the experiment.[6]

[6] We collected additional measures for exploratory purposes (administered before the ERT): a 7-item Southampton Nostalgia Scale (SNS; Routledge et al., 2008); a 10-item Nostalgia Prototype Scale (NPS; Cheung, et al., 2017); a 4-item Personal Inventory of Nostalgic Experiences (PINE; Newman et al., 2020); a 28-item Interpersonal Reactivity Index (IRI; Davis, 1980); a 20-item the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). Results regarding these measurements will not be presented.

Results

Felt Nostalgia

We present the relevant descriptive statistics in Table 4.5. To examine the effect of the nostalgia manipulation on felt nostalgia and its change over time, we conducted a 5 (timepoint: Time 1-5) x 2 (condition: nostalgia, control) mixed ANOVA, with timepoint as a within-subjects variable and condition as a between-subjects variable. The analysis revealed a significant main effect of nostalgia (vs. control) on felt nostalgia, $F(1, 134) = 14.87$, $p < .001$, $\eta_p^2 = .100$. As intended, felt nostalgia was higher in the nostalgia than control condition. The main effect of time on felt nostalgia was also significant, $F(2.58, 345.90) = 126.94$, $p < .001$, $\eta_p^2 = .486$. Across conditions, felt nostalgia decreased linearly over time, $F(1, 134) = 193.32$, $p < .001$, $\eta_p^2 = .591$.

The interaction between condition and time was significant (Figure 4.3), $F(2.58, 345.90) = 30.84$, $p < .001$, $\eta_p^2 = .187$. Felt nostalgia was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 134] = 120.68$, $p < .001$, $\eta_p^2 = .474$), and Time 2 ($F[1, 134] = 10.13$, $p = .002$, $\eta_p^2 = .070$). The difference was not significant at Time 3 ($F[1, 134] = 2.34$, $p = .128$, $\eta_p^2 = .017$), Time 4 ($F[1, 134] = 1.41$, $p = .237$, $\eta_p^2 = .010$), and Time 5 ($F[1, 134] = 0.59$, $p = .444$, $\eta_p^2 = .004$). The interaction between the condition and the linear trend was significant, $F(1, 134) = 51.54$, $p < .001$, $\eta_p^2 = .278$. The negative linear trend across timepoints in the nostalgia condition was significant, $F(1, 67) = 222.79$, $p < .001$, $\eta_p^2 = .769$. The negative linear trend across timepoints in control condition was smaller but also significant, $F(1, 67) = 22.56$, $p < .001$, $\eta_p^2 = .252$.

Psychological Benefits

To test the effects of nostalgia and time on psychological benefits, we conducted a series of 5 (timepoint: Time 1-5) x 2 (condition: nostalgia, control) mixed ANOVAs. We present relevant descriptive statistics in Table 4.6.

Positive Affect

The main effect of nostalgia (vs. control) on positive affect was significant, $F(1, 134) = 5.13$, $p = .025$, $\eta_p^2 = .037$. Positive affect was higher in the nostalgia than control condition. The main effect of time on positive affect was also significant, $F(2.41, 323.08) = 24.40$, $p < .001$, $\eta_p^2 = 154$. Across conditions, positive affect decreased linearly over time, $F(1, 134) = 39.38$, $p < .001$, $\eta_p^2 = .227$.

The interaction between condition and time was significant as well (Figure 4.4A), $F(2.41, 323.08) = 8.39$, $p < .001$, $\eta_p^2 =.059$. Positive affect was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 134] = 21.91$, $p < .001$, $\eta_p^2 = .141$), and Time 2 ($F[1, 134] = 10.24$, $p = .002$, $\eta_p^2 = .071$). The difference was not significant at Time 3 ($F[1, 134] = 3.51$, $p = .063$, $\eta_p^2 = .026$), Time 4 ($F[1, 134] = 0.49$, $p = .483$, $\eta_p^2 = .004$), and Time 5 ($F[1, 134] = 0.06$, $p = .810$, $\eta_p^2 = .000$). The interaction between condition and the linear trend was significant, $F(1, 134) = 14.52$, $p < .001$, $\eta_p^2 = .227$. The negative linear trend across timepoints in the nostalgia condition was significant, $F(1, 67) = 55.60$, $p < .001$, $\eta_p^2 = .454$. The negative linear trend across time points in control condition was not significant, $F(1, 67) = 2.80$, $p = .099$, $\eta_p^2 = 040$.

Negative Affect

The main effect of nostalgia (vs. control) on negative affect was not significant, $F(1, 134) = 0.67$, $p = .413$, $\eta_p^2 = .005$, nor was the main effect of time, $F(2.71, 363.12) = 0.98$, $p = .398$, $\eta_p^2 = .007$, or the interaction effect, $F(2.71, 363.12) = 1.99$, $p = .121$, $\eta_p^2 =.015$.

Self-Esteem

The main effect of nostalgia (vs. control) on self-esteem was significant, $F(1, 134) = 5.82$, $p = .017$, $\eta_p^2 = .042$. Self-esteem was higher in the nostalgia than control condition. The main effect of time on self-esteem was also significant, $F(2.52, 337.83) = 8.71$, p

$< .001$, $\eta_p^2 = .061$. Across conditions, self-esteem decreased linearly over time, $F(1, 134) = 16.64$, $p < .001$, $\eta_p^2 = .110$. The interaction between condition and time was not significant, $F(2.52, 337.83) = 1.86$, $p = .147$, $\eta_p^2 =.014$. Although the Condition x Time interaction was not significant, we tested the condition effect on self-esteem separately at each time point, to achieve a detailed picture. The effect on self-esteem was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 134] = 8.20$, $p = .005$, $\eta_p^2 = .058$), Time 2 ($F[1, 134] = 7.54$, $p = .007$, $\eta_p^2 = .053$), and Time 3 ($F[1, 134] = 7.25$, $p = .008$, $\eta_p^2 = .051$), but not at Time 4 ($F[1, 134] = 1.89$, $p = .171$, $\eta_p^2 = .014$), or Time 5 ($F[1, 134] = 1.25$, $p = .265$, $\eta_p^2 = .009$).

Social Connectedness

The main effect of nostalgia (vs. control) on social connectedness was significant, $F(1, 134) = 16.49$, $p < .001$, $\eta_p^2 = .110$. Social connectedness was higher in the nostalgia than control condition. The main effect of time was also significant, $F(2.32, 310.39) = 19.29$, $p < .001$, $\eta_p^2 = 126$. Across conditions, social connectedness decreased linearly over time, $F(1, 134) = 31.58$, $p < .001$, $\eta_p^2 = .191$.

The interaction between condition and time was significant (Figure 4.4B), $F(2.32, 310.39) = 9.71$, $p < .001$, $\eta_p^2 =.068$. Social connectedness was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 134] = 31.90$, $p < .001$, $\eta_p^2 = .192$), Time 2 ($F[1, 134] = 27.79$, $p < .001$, $\eta_p^2 = .172$), Time 3 ($F[1, 134] = 12.56$, $p < .001$, $\eta_p^2 = .086$), Time 4 ($F[1, 134] = 6.30$, $p = .013$, $\eta_p^2 = .045$), and Time 5 ($F[1, 134] = 5.22$, $p = .024$, $\eta_p^2 = .037$). The interaction between condition and the linear trend was significant, $F(1, 134) = 16.26$, $p < .001$, $\eta_p^2 = .108$. The negative linear trend across time points in the nostalgia condition was significant, $F(1, 67) = 53.89$, $p < .001$, $\eta_p^2 = .446$. The negative linear trend across timepoints in control condition was not significant, $F(1, 67) = 1.11$, $p = 296$, $\eta_p^2 = .016$.

Empathy

The main effect of nostalgia (vs. control) on empathy was significant, $F(1, 134) = 13.59$, $p < .001$, $\eta_p^2 = .092$. Empathy was higher in the nostalgia than control condition. The main effect of time was also significant, $F(2.62, 350.54) = 20.57$, $p < .001$, $\eta_p^2 = .133$. Across conditions, empathy decreased linearly over time, $F(1, 134) = 35.33$, $p < .001$, $\eta_p^2 = .209$.

The interaction between condition and time was significant as well (Figure 4.4C), $F(2.62, 350.54) = 6.45$, $p < .001$, $\eta_p^2 =.046$. Empathy was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 134] = 32.05$, $p < .001$, $\eta_p^2 = .193$), Time 2 ($F[1, 134] = 16.80$, $p < .001$, $\eta_p^2 = .111$), Time 3 ($F[1, 134] = 10.66$, $p = .001$, $\eta_p^2 = .074$), Time 4 ($F[1, 134] = 6.78$, $p = .010$, $\eta_p^2 = .048$), and Time 5 ($F[1, 134] = 4.18$, $p = .043$, $\eta_p^2 = .030$). The interaction between condition and the linear trend was significant, $F(1, 134) = 11.88$, $p < .001$, $\eta_p^2 = .081$. The negative linear trend across timepoints in the nostalgia condition was significant, $F(1, 67) = 41.22$, $p < .001$, $\eta_p^2 = .381$. The negative linear trend across time points in control condition was not significant, $F(1, 67) = 3.35$, $p = 072$, $\eta_p^2 = .048$.

Meaning

The main effect of nostalgia (vs. control) on meaning was significant, $F(1, 134) = 5.06$, $p = .026$, $\eta_p^2 = .036$. Meaning was higher in the nostalgia than control condition. The main effect of time on meaning was also significant, $F(2.44, 326.67) = 15.18$, $p < .001$, $\eta_p^2 = .102$. Across conditions, meaning decreased linearly over time, $F(1, 134) = 27.18$, $p < .001$, $\eta_p^2 = .169$.

The interaction between condition and time was significant as well (Figure 4.4D), $F(2.44, 326.67) = 6.96$, $p < .001$, $\eta_p^2 =.049$. Meaning was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 134] = 16.41$, $p < .001$, $\eta_p^2 = .109$), and Time 2 ($F[1, 134] = 10.08$, $p = .002$, $\eta_p^2 = .070$). The difference was not significant at Time 3 ($F[1, 134] = 2.58$, $p = .110$, $\eta_p^2 = .019$), Time 4 [$F(1, 134) = 1.61$, $p = .207$, η_p^2

= .012), and Time 5 (F[1, 134] = 0.55, p = .460, η_p^2 = .004). The interaction between condition and the linear trend was significant, F(1, 134) = 12.48, p < .001, η_p^2 = .085. The negative linear trend across timepoints in the nostalgia condition was significant, F(1, 67) = 33.28, p < .001, η_p^2 = .332. The negative linear trend across timepoints in control condition was not significant, F(1, 67) = 1.66, p = 202, η_p^2 = .024.

Self-Continuity

There was a significant main effect of nostalgia (vs. control) on self-continuity, F(1, 134) = 24.43, p < .001, η_p^2 = .154. Self-continuity was higher in the nostalgia than control condition. The main effect of time was also significant, F(2.50, 335.00) = 19.46, p < .001, η_p^2 = 127. Across conditions, self-continuity decreased linearly over time, F(1, 134) = 32.45, p < .001, η_p^2 = .195.

The interaction between condition and time was significant as well (Figure 4.4E), F(2.50, 335.00) = 4.62, p = .006, η_p^2 =.033. Self-continuity was significantly higher in the nostalgia than control condition at Time 1 (F[1, 134] = 47.97, p < .001, η_p^2 = .264), Time 2 (F[1, 134] = 33.04, p < .001, η_p^2 = .198), Time 3 (F[1, 134] = 15.45, p < .001, η_p^2 = .103), Time 4 (F[1, 134] = 10.79, p = .001, η_p^2 = .075), and Time 5 (F[1, 134] = 8.78, p = .004, η_p^2 = .062). The interaction between condition and the linear trend was significant, F(1, 134) = 8.15, p = .005, η_p^2 = .057. The negative linear trend across timepoints in the nostalgia condition was significant, F(1, 67) = 33.63, p < .001, η_p^2 = .334. The negative linear trend across timepoints in control condition was significant, F(1, 67) = 4.42, p = 039, η_p^2 = .062.

Discussion

Experiment 1 replicated a number of findings from the preliminary investigation. As in the preliminary investigation, the effect of nostalgia (vs. control) on felt nostalgia dissipated after the second time point (i.e., after five minutes) and beneficial nostalgia effects on social connectedness and self-continuity persisted for the duration of the entire

20-minute study. With regard to other outcome measures, Experiment 1 produced stronger effects than the preliminary investigation. The beneficial nostalgia effect on empathy was significant at all five time points (vs. only at Time 1 in the preliminary investigation). Further, Experiment 1 demonstrated beneficial nostalgia effects on positive affect (Time 1-2), self-esteem (Time 1-3), and meaning (Time 1-2) (vs. no significant effects in the preliminary investigation).

Experiment 2

The key objective of Experiment 2 was to replicate and extend Experiment 1 by examining the efficacy of a novel nostalgia induction based on VR, and comparing its effectiveness to the ERT. Whereas the ERT is a well-established nostalgia induction (Sedikides et al., 2015), it has received some criticism. For example, Newman et al. (2020) argued that the ERT's instructions that participants recall their "most" nostalgic experience may prompt the recall of atypically positive nostalgic memories. VR, on the other hand, may offer an immersive and interactive environment that can simulate past experiences with a greater degree of fidelity (Diemer et al., 2015; Diniz Bernardo et al., 2021; Freeman et al., 2017). We employed VR technology and centred our investigation around general nostalgic themes, including Christmas, birthdays, and childhood. In doing so, we implemented a nomothetic approach, that is, we presented stimuli that were expected to elicit nostalgia for most individuals in our sample (vs. control stimuli; Dimitriadou et al., 2019; Redhead et al., 2023). We compared this nomothetic VR approach to the idiographic ERT approach, which prompts participants to recall memories from their personal past. We expected that the duration of the felt nostalgia and its psychological benefits would be prolonged when nostalgia is induced with VR (compared to ERT), due to VR's immersive and involving nature (Riva et al., 2016; Riva et al., 2019).

Method

Participants

To determine the sample size to test the study hypotheses, we conducted an a priori power analysis using G*Power 3.1 (Faul et al., 2007). We found that we needed 136 participants to achieve 80% power for detecting a medium effect size, f ~ .25, at a significance criterion of $\alpha = .05$. In total, we recruited two hundred and forty-eight participants (76 men, 169 women, 2 other, 1 preferred not to say) account for potential data exclusions, and they completed the experiment in a laboratory setting ($M_{age} = 24.31$ years, $SD_{age} = 7.81$, $Range_{age} = 18\text{-}70$). Fifty-six per cent of the participants stated that their first language is English. We recruited undergraduate psychology students and staff from the University of Southampton. Students took part in exchange for course credits. We remunerated staff with £5 per hour. All participants gave informed online consent before participating in the experiment. The experimental protocol was approved by the Ethics Committee of the University of Southampton (Reference: 47153.A5).

VR Stimuli

Nostalgic memories often include momentous events (e.g., holidays, anniversaries and birthdays), loved ones (e.g., family members and friends), and important time periods in life (e.g., childhood and college years; Batcho, 1995; Wildschut et al., 2006; Holak & Havlena, 1992). Based on this evidence, we chose Christmas, childhood, and birthday themes to develop nostalgic virtual environments. Although the Christmas-themed scene might not resonate culturally with every participant, we addressed this by offering two alternative options that connect with memories — a playground scene and a birthday party-themed scene. We purchased the task-related items from the Unity Asset Store (https://assetstore.unity.com/). For the Christmas and birthday scenes, we created three-dimensional virtual living rooms with theme-related items (e.g., Christmas tree, birthday cake). For the childhood theme, we created a three-dimensional virtual playground with theme-related items (e.g., swing, seesaw). We also created human-like avatars for the playground scene to increase its resemblance to real life. For this, we used Autodesk® Character Generator (https://charactergenerator.autodesk.com). We added scene-related sounds to all three environments. For the birthday and Christmas scenes, we used several different clips and joined them together using Audacity (https://www.audacityteam.org/), which is a free audio editor. For the playground scene, we added an ambient park sound that was looped continuously. For the control condition, we presented blank virtual environments with identical dimensions but without nostalgia-related cues (Baños et al., 2008; Diemer et al., 2015). We presented each environment through Unity 3.2f.1 game engine (Unity Software, version 2018, 3.2f.1), using an Oculus Rift VR head-mounted display with 1080 × 1200 resolution per eye (Facebook Inc.). We used a Dell computer with an Intel i7 processor and Windows 10 operating system.

Nostalgia Inductions

Virtual Reality Task (VRT)

We used the VRT as one of two induction methods. In the nostalgia condition, we offered participants three options: a three-dimensional virtual living room with a Christmas theme (Figure 4.5A), a three-dimensional virtual living room with a birthday theme (Figure 4.5B), and a three-dimensional virtual children's playground (Figure 4.5C), We instructed participants to don the VR headset, choose one of the three nostalgic environments, and read the following instructions.

> According to the Oxford Dictionary, 'nostalgia' is defined as a sentimental longing for the past. Please think of a nostalgic event in your life related to the virtual scene that you chose. Specifically, try to think of a past event that makes you feel most nostalgic regarding the virtual environment that you are in now. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel? For the next five minutes, we would like you to talk about

> the nostalgic event while looking around. Immerse yourself in this nostalgic experience. Describe the experience in detail and how it makes you feel. Please push the button on the controller and start describing your nostalgic memory.

For the control condition, we presented the blank versions of the three environments presented in the nostalgia condition (i.e. two three-dimensional empty living rooms (Figure 4.5D and Figure 4.5E), and a three-dimensional empty playground (Figure 4.5F)). Then, we instructed participants to don the VR headset, choose one of the three empty virtual environments, and read the following instructions.

> Please bring to mind an ordinary event (everyday, regular) in your life. Specifically, try to think of an event that is ordinary. Bring this ordinary experience in mind. Immerse yourself in the ordinary experience. How does it make you feel? For the next five minutes, we would like you to talk about the ordinary event while looking around. Immerse yourself into this ordinary experience. Describe the experience in detail and how it makes you feel. Please push the button on the controller and start describing your ordinary memory.

Participants in both conditions verbally described their nostalgic or ordinary experience and then listed four keywords to summarise the event.

ERT

We used a modified version of the ERT (Sedikides et al., 2015). Specifically, we instructed participants to recall a personal nostalgic memory related to either a Christmas holiday, their childhood, or one of their past birthdays.

> According to the Oxford Dictionary, 'nostalgia' is defined as 'a sentimental longing for the past.' Please think of a nostalgic event in your life related to either (a) a Christmas Holiday, (b) your childhood, or (c) one of your birthdays. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this nostalgic

experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel? Using the space provided below, for the next five minutes, we would like you to write about the nostalgic event. Immerse yourself in this nostalgic experience. Describe the experience in detail and how it makes you feel.”.

Instructions in the control condition were identical to those used in the preliminary investigation and Experiment 1. Participants in both conditions wrote about their nostalgic or ordinary experiences and then listed four keywords to summarise the event.

Procedure

We randomly assigned participants to one of the four experimental conditions: ERT-nostalgia, $n = 62$; ERT-control, $n = 62$; VRT-nostalgia, $n = 62$; VRT-control, $n = 62$. The experiment lasted approximately 45 minutes and was completed online in a single session.

Following the ERT/VRT, we assessed felt nostalgia and psychological benefits (i.e., positive affect, negative affect, self-esteem, social connectedness, empathy, meaning, self-continuity) at five timepoints, using the same items as in the preliminary investigation and Experiment 1. We used the same filler task as in Experiment 1 to fill the four 5-minute intervals between timepoints. We present descriptive statistics and reliabilities in Table 4.7. After the final assessment, participants provided demographic information and were fully debriefed about the purpose of the experiment.[7]

[7] We collected additional measurements for exploratory purposes (administered before the ERT): a 7-item Southampton Nostalgia Scale (SNS; Routledge et al., 2008); a 10-item Nostalgia Prototype Scale (NPS; Cheung, et al., 2017); a 4-item Personal Inventory of Nostalgic Experiences (PINE; Newman et al., 2020); Presence Questionnaire (PQ; Witmer & Singer, 1998); a 28-item Interpersonal Reactivity Index (IRI; Davis, 1980); a 20-item the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). Results regarding these measurements will not be presented.

Results

Felt Nostalgia

We present descriptive statistics in Table 4.8. We conducted a 5 (timepoint: Time 1-5) x 2 (condition: nostalgia, control) x 2 (induction method: ERT, VRT) three-way mixed design ANOVA. The analysis revealed a significant main effect of nostalgia (vs. control), $F(1, 244) = 32.41$, $p < .001$, $\eta_p^2 = .117$, indicating that felt nostalgia was higher in the nostalgia than in the control condition. The main effect of time on felt nostalgia was also significant, $F(2.41, 589.00) = 206.71$, $p < .001$, $\eta_p^2 = .459$. Felt nostalgia decreased linearly over time, $F(1, 244) = 341.61$, $p < .001$, $\eta_p^2 = .583$. There was no significant main effect of the induction method, $F(1, 244) = 1.50$, $p = .222$, $\eta_p^2 = .006$.

There was a significant interaction between the time and condition, $F(2.41, 589.00) = 23.31$, $p < .001$, $\eta_p^2 = .087$. Felt nostalgia was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 246] = 109.46$, $p < .001$, $\eta_p^2 = .308$), Time 2 ($F[1, 246] = 17.75$, $p < .001$, $\eta_p^2 = .067$), Time 3 ($F[1, 246] = 10.10$, $p = .002$, $\eta_p^2 = .039$), and Time 4 ($F[1, 246] = 4.89$, $p = .028$, $\eta_p^2 = .019$). The difference was not significant at Time 5 ($F[1, 246] = 0.66$, $p = .418$, $\eta_p^2 = .003$). The interaction between condition and the linear trend was significant, $F(1, 244) = 43.30$, $p < .001$, $\eta_p^2 = .151$. The negative linear trend across timepoints in the nostalgia condition was significant, $F(1, 122) = 348.87$, $p < .001$, $\eta_p^2 = .741$. The negative linear trend across timepoints in control condition was smaller but also significant, $F(1, 122) = 64.41$, $p < .001$, $\eta_p^2 = .346$.

The interaction between condition and induction method was also significant, $F(1, 244) = 5.72$, $p = .018$, $\eta_p^2 = .023$. The test of simple induction-method effects revealed that, in the nostalgia condition, the level of felt nostalgia did not differ significantly between the VRT and ERT (Figure 4.6A), ($F[1, 244] = 0.68$, $p = .410$, $\eta_p^2 = .003$). In the control condition, however, participants felt less nostalgic in the VRT ($M = 2.26$, $SD = 0.14$) than in the ERT ($M = 2.76$, $SD = 0.14$), (Figure 4.6A), ($F[1, 244] = 6.54$, $p = .011$, $\eta_p^2 = .026$).

Tests of simple condition effects revealed that, in the VRT, felt nostalgia was higher for those in nostalgia (compared to control) condition (Figure 4.6B), (F[1, 244] = 32.68, p < .001, η_p^2 = .118). In the ERT, felt nostalgia was also higher in the nostalgia than in the control condition, although this effect was smaller than in the VRT (Figure 4.6B), (F[1, 244] = 5.45, p = .020, η_p^2 = .022).

The interaction between time and induction method was significant as well, F(2.41, 589.00) = 4.65, p = .006, η_p^2 = .019. The simple effect analysis indicated that felt nostalgia differed across time points in the VRT (F[4, 241] = 49.44, p < 001, η_p^2 = .451) and in the ERT (F[4, 241] = 47.66, p < 001, η_p^2 = .442) (Figure 4.7A). When comparing the effect of induction methods at each timepoint, Figure 4.7B demonstrated that felt nostalgia was significantly higher in the ERT than VRT at Time 1 (F[1, 244] = 4.79, p = 030, η_p^2 = .019) and Time 5 (F[1, 244] = 7.40, p = 007, η_p^2 = .029). However, there was no significant difference between ERT and VRT in felt nostalgia at Time 2, Time 3, or Time 4 (Fs < 1.51, ps > .221). The interaction between the induction method and the linear trend was not significant, F(1, 244) = 1.23, p = .269, η_p^2 = .005. The negative linear trend across timepoints in VRT was significant, F(1, 122) = 227.82, p < .001, η_p^2 = .651. The negative linear trend across timepoints in ERT was smaller but also significant, F(1, 122) = 130.38, p < .001, η_p^2 = .517. The three-way interaction was not significant, F(2.41, 589.00) = 1.03, p = .367, η_p^2 = .004.

Psychological Benefits

We present the relevant descriptive statistics in Table 4.8. To examine the effect of nostalgia manipulation on felt nostalgia and its change over time, and to compare the nostalgia induction methods, we conducted a 3-way mixed design ANOVA.

Positive Affect

The main effect of nostalgia (vs. control) on positive affect was not significant, F(1, 244) = 1.91, p = .169, η_p^2 = .008. The main effect of time was significant, F(2.75, 669.88)

= 67.33, $p < .001$, $\eta_p^2 = .216$. Positive affect decreased linearly over time, $F(1, 244) = 125.49$, $p < .001$, $\eta_p^2 = .340$. The main effect of induction method was not significant, $F(1, 244) = 0.09$, $p = .770$, $\eta_p^2 = .000$.

The interaction between condition and time was significant, $F(2.75, 669.88) = 4.84$, $p = .003$, $\eta_p^2 = .019$. Positive affect was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 246] = 5.65$, $p = .015$, $\eta_p^2 = .024$), Time 2 ($F[1, 246] = 4.23$, $p = .041$, $\eta_p^2 = .017$), and Time 3 ($F[1, 246] = 4.87$, $p = .028$, $\eta_p^2 = .019$). The difference was not significant at Time 4 ($F[1, 246] = 0.01$, $p = .907$, $\eta_p^2 = .000$), and Time 5 ($F[1, 246] = 0.16$, $p = .691$, $\eta_p^2 = .001$). The interaction between condition and the linear trend was significant, $F(1, 244) = 8.11$, $p = .005$, $\eta_p^2 = .032$. The negative linear trend across timepoints in the nostalgia condition was significant, $F(1, 122) = 94.17$, $p < .001$, $\eta_p^2 = .436$. The negative linear trend across timepoints in control condition was smaller but significant, $F(1, 122) = 36.66$, $p < .001$, $\eta_p^2 = .231$.

The interaction between condition and induction method was not significant, $F(1, 244) = 0.64$, $p = .425$, $\eta_p^2 = .003$, nor was the interaction between time and induction method, $F(2.75, 669.88) = 1.36$, $p = .257$, $\eta_p^2 = .006$, or the three-way interaction, $F(2.75, 669.88) = 0.78$, $p = .496$, $\eta_p^2 = .003$.

Negative Affect

The main effect of nostalgia (vs. control) was not significant, $F(1, 244) = 0.42$, $p = .519$, $\eta_p^2 = .002$, nor was the main effect of time, $F(2.91, 710.59) = 1.72$, $p = .163$, $\eta_p^2 = .007$, or the main effect of induction method, $F(1, 244) = 0.12$, $p = .726$, $\eta_p^2 = .001$. None of the interactions effects were significant: Time x Condition, $F(2.91, 710.59) = 0.22$, $p = .876$, $\eta_p^2 = .001$; Condition x Induction Method, $F(1, 244) = 2.76$, $p = .098$, $\eta_p^2 = .011$; Time x Induction Method, $F(2.91, 710.59) = 1.62$, $p = .184$, $\eta_p^2 = .007$; Time x Condition x Induction Method, $F(2.91, 710.59) = 1.57$, $p = .197$, $\eta_p^2 = .006$.

Self-Esteem

The main effect of nostalgia (vs. control) on self-esteem was not significant, $F(1, 244) = 0.12$, $p = .735$, $\eta_p^2 = .000$. The main effect of time was significant, $F(2.84, 692.52) = 27.93$, $p < .001$, $\eta_p^2 = .103$. Self-esteem decreased linearly over time, $F(1, 244) = 51.69$, $p < .001$, $\eta_p^2 = .175$. There was a significant main effect of the induction method, $F(1, 244) = 4.02$, $p = .046$, $\eta_p^2 = .016$. Self-esteem was higher in the ERT than VRT condition.

There was a significant interaction between time and induction method, $F(2.84, 692.52) = 2.76$, $p = .045$, $\eta_p^2 = .011$. The simple effect analysis indicated that self-esteem varied across time points in both the VRT ($F[4, 241] = 10.46$, $p < 001$, $\eta_p^2 = .148$) and ERT ($F[4, 241] = 7.00$, $p < 001$, $\eta_p^2 = .104$) (Figure 4.8A). When testing the effect of the induction method at each time point, self-esteem was significantly higher in the ERT than VRT at Time 3 ($F[1, 244] = 4.05$, $p = 045$, $\eta_p^2 = .016$) and at Time 5 ($F[1, 244] = 8.77$, $p = 003$, $\eta_p^2 = .035$). However, there was no significant difference between ERT and VRT at Time 1, Time 2, or Time 4 (Fs < 2.56, ps $> .111$) (Figure 4.8B). The interaction between induction method and the linear trend was not significant, $F(1, 244) = 2.55$, $p = .112$, $\eta_p^2 = .010$. The negative linear trend across timepoints in VRT was significant, $F(1, 122) = 36.20$, $p < .001$, $\eta_p^2 = .229$. The negative linear trend across timepoints in ERT was smaller but also significant, $F(1, 122) = 16.75$, $p < .001$, $\eta_p^2 = .121$.

The interaction effect between time and condition was not significant, $F(2.84, 692.52) = 1.11$, $p = .344$, $\eta_p^2 = .005$, nor was the interaction between condition and induction method, $F(1, 244) = 1.89$, $p = .170$, $\eta_p^2 = .008$, or the three-way interaction, $F(2.84, 692.52) = 1.43$, $p = .234$, $\eta_p^2 = .006$.

Social Connectedness

The main effect of nostalgia (vs. control) on social connectedness was significant, $F(1, 244) = 30.00$, $p < .001$, $\eta_p^2 = .109$, indicating that social connectedness was higher in the nostalgia than in the control condition. The main effect of time was also significant, $F(3.02, 736.19) = 35.27$, $p < .001$, $\eta_p^2 = .126$. Social connectedness decreased linearly over time, $F(1, 244) = 70.55$, $p < .001$, $\eta_p^2 = .224$. The main effect of the induction method was not significant, $F(1, 244) = 1.28$, $p = .258$, $\eta_p^2 = .005$.

There was a significant interaction effect between the time and condition, $F(3.02, 736.19) = 5.54$, $p < .001$, $\eta_p^2 = .022$. Social connectedness was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 246] = 53.72$, $p < .001$, $\eta_p^2 = .179$), Time 2 ($F[1, 246] = 25.50$, $p < .001$, $\eta_p^2 = .094$), Time 3 ($F[1, 246] = 21.53$, $p < .001$, $\eta_p^2 = .080$), Time 4 ($F[1, 246] = 17.26$, $p < .001$, $\eta_p^2 = .066$), and Time 5 ($F[1, 246] = 12.41$, $p < .001$, $\eta_p^2 = .048$). The interaction between condition and the linear trend was significant, $F(1, 244) = 12.14$, $p < .001$, $\eta_p^2 = .047$. The negative linear trend across timepoints in the nostalgia condition was significant, $F(1, 122) = 60.98$, $p < .001$, $\eta_p^2 = .333$. The negative linear trend across timepoints in control condition was smaller but significant, $F(1, 122) = 14.34$, $p < .001$, $\eta_p^2 = .105$.

The interaction between condition and induction was not significant, $F(1, 244) = 0.39$, $p = .531$, $\eta_p^2 = .002$, nor was the interaction between time and induction method, $F(3.02, 736.19) = 0.42$, $p = .740$, $\eta_p^2 = .002$, or the three-way interaction, $F(3.02, 736.19) = 0.54$, $p = .656$, $\eta_p^2 = .002$.

Empathy

The main effect of nostalgia (vs. control) on empathy was significant, $F(1, 244) = 15.87$, $p < .001$, $\eta_p^2 = .061$, indicating that empathy was higher in the nostalgia than in the control condition. The main effect of time was also significant, $F(2.72, 664.85) = 58.33$, $p < .001$, $\eta_p^2 = .193$. Empathy decreased linearly over time, $F(1, 244) = 107.77$, $p < .001$, $\eta_p^2 = .306$. The main effect of induction method was not significant, $F(1, 244) = 1.18$, $p = .279$, $\eta_p^2 = .005$.

There was a significant interaction between time and condition, $F(2.72, 664.85) = 5.25$, $p = .002$, $\eta_p^2 = .021$. Empathy was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 246] = 35.66$, $p < .001$, $\eta_p^2 = .127$), Time 2 ($F[1, 246] = 17.98$, p

$< .001$, $\eta_p^2 = .068$), Time 3 (F[1, 246] = 10.28, $p = .002$, $\eta_p^2 = .040$), Time 4 (F[1, 246] = 6.18, $p = .014$, $\eta_p^2 = .025$), and Time 5 (F[1, 246] = 6.63, $p = .011$, $\eta_p^2 = .026$). The interaction between condition and the linear trend was significant, $F(1, 244) = 9.08$, $p = .003$, $\eta_p^2 = .036$. The negative linear trend across timepoints in the nostalgia condition was significant, $F(1, 122) = 77.43$, $p < .001$, $\eta_p^2 = .388$. The negative linear trend across timepoints in control condition was smaller but also significant, $F(1, 122) = 32.26$, $p < .001$, $\eta_p^2 = .209$.

The interaction between condition and induction method was not significant, $F(1, 244) = 1.09$, $p = .297$, $\eta_p^2 = .004$, nor was the interaction between time and induction method, $F(2.72, 664.85) = 1.89$, $p = .136$, $\eta_p^2 = .008$, or the three-way interaction, $F(2.72, 664.85) = 0.77$, $p = .500$, $\eta_p^2 = .003$.

Meaning

The main effect of nostalgia (vs. control) on meaning was not significant, $F(1, 244) = 0.64$, $p = .425$, $\eta_p^2 = .003$. The main effect of time was significant, $F(2.75, 671.32) = 43.61$, $p < .001$, $\eta_p^2 = .152$. Meaning decreased linearly over time, $F(1, 244) = 79.15$, $p < .001$, $\eta_p^2 = .245$. There was no significant main effect of the induction method, $F(1, 244) = 3.69$, $p = .056$, $\eta_p^2 = .015$. None of the interactions effects were significant: Time x Condition, $F(2.75, 671.32) = 0.93$, $p = .420$, $\eta_p^2 = .004$; Condition x Induction Method, $F(1, 244) = 2.40$, $p = .123$, $\eta_p^2 = .010$; Time x Induction Method, $F(2.75, 671.32) = 1.99$, $p = .120$, $\eta_p^2 = .008$; Time x Condition x Induction Method, $F(2.75, 671.32) = 2.35$, $p = .077$, $\eta_p^2 = .010$.

Self-Continuity

The main effect of nostalgia (vs. control) on self-continuity was significant, $F(1, 244) = 19.19$, $p < .001$, $\eta_p^2 = .073$, indicating that self-continuity was higher in the nostalgia than in the control condition. The main effect of time was significant, $F(2.89, 704.24) = 56.86$, $p < .001$, $\eta_p^2 = .189$. Self-continuity decreased linearly over time, F(1,

244) = 113.39, $p < .001$, $\eta_p^2 = .317$. The main effect of induction method was significant, $F(1, 244) = 5.12$, $p = .025$, $\eta_p^2 = .021$, indicating that self-continuity was higher in the ERT than in VRT.

There was a significant interaction effect between time and condition, $F(2.89, 704.24) = 4.76$, $p = .003$, $\eta_p^2 = .019$. Self-continuity was significantly higher in the nostalgia than control condition at Time 1 ($F[1, 246] = 49.72$, $p < .001$, $\eta_p^2 = .168$), Time 2 ($F[1, 246] = 14.02$, $p < .001$, $\eta_p^2 = .054$), Time 3 ($F[1, 246] = 9.25$, $p = .003$, $\eta_p^2 = .036$), Time 4 ($F[1, 246] = 9.37$, $p = .002$, $\eta_p^2 = .037$), and Time 5 ($F[1, 246] = 7.29$, $p = .007$, $\eta_p^2 = .029$). The interaction between condition and the linear trend was significant, $F(1, 244) = 6.82$, $p = .010$, $\eta_p^2 = .027$. The negative linear trend across timepoints in the nostalgia condition was significant, $F(1, 122) = 89.81$, $p < .001$, $\eta_p^2 = .424$. The negative linear trend across timepoints in control condition was smaller but also significant, $F(1, 122) = 31.63$, $p < .001$, $\eta_p^2 = .206$.

The interaction between condition and induction method was not significant, $F(1, 244) = 0.02$, $p = .901$, $\eta_p^2 = .000$, nor was the interaction between time and induction method, $F(2.89, 704.24) = 1.98$, $p = .118$, $\eta_p^2 = .008$, or the three-way interaction, $F(2.89, 704.24) = 1.64$, $p = .180$, $\eta_p^2 = .007$.

Discussion

Felt Nostalgia

The findings were consistent with Experiment 1, and the analysis revealed several significant main effects and two-way interactions, providing insights into the influence of condition and induction method on felt nostalgia at different timepoints.

First, there was a significant main effect of condition, indicating that participants reported higher levels of felt nostalgia in the nostalgia condition compared to the control condition. This finding supports the effectiveness of nostalgia induction in evoking nostalgic experiences among participants. Second, there was a significant main effect of time on felt nostalgia, suggesting that felt nostalgia varied across different time points. Specifically, felt nostalgia showed a linear decrease over time, indicating a decline in nostalgic feelings as the experiment progressed. Third, the main effect of the induction method was not significant, suggesting that the type of induction (ERT or VRT) did not significantly influence the overall levels of felt nostalgia. This implies that participants who underwent VRT did not differ significantly in their reported levels of felt nostalgia compared to those who underwent ERT.

As for the two-way interactions, first, there was a significant interaction between time and condition, indicating that the effect of condition on felt nostalgia varied across different timepoints. Participants in the nostalgia condition consistently reported higher levels of felt nostalgia compared to the control condition at Time 1-4, but this difference was not significant at Time 5. This suggests that the immediate impact of nostalgia induction was stronger, but declined over time. Second, the interaction between condition and induction method was significant, indicating that the condition effect on felt nostalgia differed depending on the induction method. Specifically, the difference in felt nostalgia between the nostalgia and control conditions was larger in the VRT than in the ERT. This suggests that the VRT induction method might be more effective in enhancing the experience of nostalgia compared to ERT. Moreover, although we observed no significant difference in the felt nostalgia between ERT and VRT among participants in the nostalgia condition, our findings indicate that, in the control condition, felt nostalgia was lower in the VRT than ERT. The purpose of nostalgia induction is to create experimental conditions that differ in felt nostalgia. In this regard, the VRT was more effective than the ERT. Third, the interaction between time and induction method was significant, indicating that the difference between VRT and ERT varied across timepoints. Specifically, felt nostalgia was higher in the ERT than VRT at Time 1 and Time 5, while no significant differences were found at Time 2, Time 3, and Time 4.

The finding that the effect of condition on felt nostalgia was stronger in the VRT than the ERT aligns with the prior evidence for the importance of trigger intensity in eliciting emotion (Moors et al., 2013; Schimmack, 2003; Sonnemans and Frijda, 1995; Verduyn et al., 2009). Furthermore, this finding is consistent with prior research demonstrating the efficacy of VR in evoking intense emotional experiences (Diniz Bernardo et al., 2021; Felnhofer et al., 2015; Rivu et al., 2021).

Psychological Benefits

Regarding psychological benefits, we replicated Experiment 1 results. In particular, we observed significant main effects of nostalgia (compared to control) on social connectedness, empathy, and self-continuity, such that scores were higher in the nostalgia than control condition. Furthermore, we observed significant main effects of time on positive affect, self-esteem, social connectedness, empathy, meaning, and self-continuity, such that scores tended to decrease linearly over time. We also observed a significant main effect of the induction method on self-esteem and self-continuity, with higher scores in the ERT than in VRT.

There were significant two-way interaction effects between time and condition on positive affect, social connectedness, empathy, and self-continuity. Particularly, participants in the nostalgia (compared to control) condition exhibited a statistically significant difference in their reported levels of positive affect at Time 1-3, but the difference was not significant at Time 4 or Time 5. Participants in the nostalgia (compared to the control) condition exhibited a statistically significant difference in social connectedness, empathy, and self-continuity across all five time points but the magnitude of this effect declined over time.

The interaction between condition and induction method was not significant for any of the psychological benefits, indicating that the condition effect was not stronger (or weaker) in the VRT than in the ERT. The interaction effect between time and induction method was significant for self-esteem. Self-esteem was significantly higher in the ERT than VRT at Time 3 and Time 5 but not at other time points.

Overall, these results were consistent with previous studies highlighting nostalgia as a source of social connectedness (Wildschut et al., 2010), self-continuity (Sedikides et al., 2015), and empathy (Sedikides & Wildschut, 2019). Additionally, this study made a valuable contribution to the literature by demonstrating that the psychological benefits of nostalgia, specifically social connectedness, empathy, and self-continuity, are experienced over an extended period.

General Discussion

Whereas there is growing scholarly interest in the study of emotion duration, to date the duration of experimentally-induced nostalgia and its psychological benefits has not been examined. We conducted two experiments and a preliminary investigation to address this lacuna.

Summary of Findings

In the preliminary investigation, the effect of nostalgia induction on felt nostalgia was significant at the first and the second time points (for around five minutes). However, this effect was no longer significant after the 15-minute filler task, at the third time point. The preliminary investigation also demonstrated that the psychological benefits of nostalgia tended to decrease over time, yet self-continuity and social connectedness persisted for around 20 minutes.

In Experiment 1, we assessed the duration of the felt nostalgia five times in total and used a 20-minute filler task between the time intervals. As intended, we found that recalling a nostalgic (compared with an ordinary) event increased felt nostalgia, and we observed a significant main effect of time, suggesting that felt nostalgia varied across different time points. The findings of Experiment 1 are in agreement with the existing literature demonstrating the fluctuations in emotions over time (Gilboa & Revelle, 1994; Houben et al., 2015; Kuppens & Verduyn, 2017; Verduyn et al., 2012). We also found in Experiment 1 that the effect of condition on felt nostalgia varied across different timepoints. Participants in the nostalgia (compared to control) condition consistently reported higher levels of felt nostalgia at Times 1-2, but this difference was not significant at Times 3-5. Further, we explored how long the psychological benefits of nostalgia lasted. Recalling a nostalgic (compared to ordinary) event increased positive affect, self-esteem, social connectedness, empathy, meaning, and self-continuity. The main effect of time indicated that these psychological benefits tended to decrease linearly across time points. Importantly, we demonstrated significant interaction effects between time and condition on positive affect, social connectedness, empathy, meaning, and self-continuity. Particularly, participants in the nostalgia (compared to the control) condition exhibited significantly higher levels of positive affect and meaning at Times 1-2 but not at Times 3-5. The beneficial effects of nostalgia (compared to control) on self-continuity, social connectedness, and empathy lasted until the fifth time point (for 20 minutes).

In Experiment 2, we induced nostalgia using VRT, in addition to the ERT, and compared those methods in terms of their efficacy in prolonging the duration of felt nostalgia and its psychological benefits. In accordance with previous research indicating a positive correlation between the intensity of the initial trigger and the duration of the resulting emotional experience (Frijda; 2007; Moors et al., 2013; Schimmack, 2003; Verduyn et al., 2015), we predicted that the duration of felt nostalgia and its beneficial effects would be extended following the VRT induction. We found that participants in the nostalgia (compared to control) condition reported higher levels of felt nostalgia. We further found a main effect of time, such that felt nostalgia decreased linearly over time. We did not find a significant main effect of the induction method (ERT or VRT), which indicated that the participants did not differ significantly in their level of felt nostalgia based on the induction method. Leveraging immersive audio-visual content for the recreation of authentic real-world settings through the use of 360° cameras, for capturing omnidirectional panoramic images, may prove advantageous in augmenting the potency of nostalgia manipulation (Kim et al., 2022; Kim et al., 2020). Importantly, we found an interaction effect between the condition and induction method on felt nostalgia, such that the difference in felt nostalgia between the nostalgia and control conditions was more pronounced in the VRT than ERT.

As to the benefits of nostalgia, we found that participants in the nostalgia (compared to the control) condition reported higher levels of social connectedness, empathy, and self-continuity at all five time points, regardless of the induction method. We did not find significant two-way interaction effects between condition and induction method nor significant three-way interaction effects between condition, induction method, and time. These null findings indicate that VRT was not more effective than ERT in producing the beneficial effects of nostalgia (compared to control) or in extending these effects over time.

In conclusion, we investigated the temporal dynamics of nostalgia and its psychological benefits in a preliminary investigation and two Experiments. Results demonstrated that, whereas nostalgia (compared to control) generally conveyed psychological benefits, these beneficial nostalgia effects tended to decrease linearly over time (Figure 4.9).

Broader Implications

Our findings informed hitherto unanswered questions concerning the duration of nostalgia and its psychological benefits. In addition, we gained insight into the differences between nostalgia-elicitation methods. Although it can be difficult to tailor virtual environments to evoke specific emotions (Riva et al., 2007; Felnhofer et al., 2015), our virtual environments were able to induce nostalgia. In fact, our findings indicated that the difference in felt nostalgia between the nostalgia and control conditions was stronger when nostalgia was induced through VRT than ERT. Indeed, our results demonstrated VR's capacity to strengthen and prolong nostalgia effects for felt nostalgia (see Figure 4.9A, for the temporal change in nostalgia (compared to control) effect on felt nostalgia across studies). The sustained influence of VR in intensifying the nostalgic experience highlights the potential of VR-based elicitations to enhance the emotion's impact and beneficial effects.

Our findings suggest interventional potential. Although, when considering the cost of VR, the ERT might offer better value for money, VR still presents a novel and effective means of inducing nostalgia and its psychological benefits. This approach could be especially useful for individuals who struggle with remembering or reporting on their autobiographical memories, as VR allows for controlled and immersive re-experiencing of past events (Diniz Bernardo et al., 2021; Lindner et al., 2017; Wilson & Soranzo, 2015). The application of VR to elicit feelings of nostalgia may be beneficial for individuals experiencing difficulties in recollecting autobiographical memories, such as those affected by neurodegenerative conditions like Alzheimer's Disease or Dementia (Ismail et al., 2018; Jack et al., 2011). With the assistance of personalised virtual nostalgic environments, it might be easier to trigger memories and evoke nostalgia, which potentially results in strengthened social bonds and a sense of social connectedness (Abeyta et al., 2015; Sedikides et al., 2015). Furthermore, VR-based nostalgia inductions might be implemented in therapeutic settings.

Limitations and Future Directions

There are a number of limitations that can be addressed by future research. Our nostalgia inductions were brief, lasting no more than five minutes. Frijda (2007) posited that there is a positive association between the duration of the event that instigates an emotional reaction and the duration of the ensuing emotional response. Considering this, future studies may assess how induction time affects the duration of nostalgia by providing longer nostalgia inductions. Additionally, future studies may take into consideration reactivating the evoked emotion multiple times throughout the experiment, as research has shown that the physical reappearances of the eliciting source prolong the emotional event (Verduyn et al., 2009).

Second, in all three experiments, the nostalgia effects on social connectedness and self-continuity persisted until the end of the session, that is, for 20 minutes. Future studies could consider longer timescales, to examine if these psychological benefits endure for more than 20 minutes and, if so, for how long. According to existing literature, heightened intensity at the onset of emotion is associated with a prolonged duration of the emotional experience (Schimmack, 2003; Sonnemans & Frijda, 1994). Lench, Flores, and Bench (2011) conducted a meta-analysis of experimental emotion elicitations to explore the efficacy and magnitude of the effects of those methods. They found that films, pictures, and music had a larger effect size compared to other induction methods in terms of elicitation efficacy. Therefore, employing induction methods that potentially lead to higher intensity may prove to be a useful approach in extending the duration of the elicited emotion.

Third, in Experiments 1-2, we used a twenty-minute filler task to fill the intervals between timepoints. This filler task may have distracted participants and diverted attention away from the emotion-eliciting event (Gross, 2007; Hollenstein, 2015). Future experiments may examine the change in the duration of felt nostalgia and its psychological benefits without a filler task between time points.

Conclusion

Our experiments are the first to explore the duration of nostalgic emotional episodes and their psychological benefits, and to compare different induction methods. The current findings shed light on how nostalgia and its psychological benefits change over time. Our work demonstrated the viability of inducing nostalgia with VR, highlighting this technology's interventional potential.

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Tables

Table 4.1

Descriptives and Reliabilities for the Time 1 and Time 3 Measures for the Psychological Benefits (n = 162)

Benefits of Nostalgia	α	*M*	*SD*
Time 1			
Positive Affect	.89	4.02	1.40
Negative Affect	.90	2.27	1.47
Self-esteem	.94	3.73	1.43
Self-continuity	.77	4.10	1.45
Social connectedness	.93	3.86	1.68
Meaning	.94	4.06	1.58
Empathy	.95	3.71	1.52
Time 3			
Positive Affect	.90	3.74	1.39
Negative Affect	.91	2.30	1.42
Self-esteem	.94	3.63	1.41
Self-continuity	.89	3.80	1.46
Social connectedness	.94	3.55	1.59
Meaning	.95	3.81	1.56
Empathy	.96	3.57	1.46

Table 4.2

Means And Standard Deviations Across Time-Points for the Felt Nostalgia Across the Experimental Conditions

Felt Nostalgia	Nostalgia *n* = 82		Control *n* = 80	
	M	*SD*	*M*	*SD*
Time 1	5.63	1.28	4.09	1.80
Time 2	4.05	1.66	3.45	1.73
Time 3	2.70	1.70	2.98	1.68

Table 4.3

Means And Standard Deviations Across Time Points for the Psychological Benefits Across the Experimental Conditions

Benefits of Nostalgia	Nostalgia n = 82		Control n = 80	
	M	*SD*	*M*	*SD*
Time 1				
Positive Affect	4.14	1.12	3.89	1.13
Negative Affect	2.22	1.20	2.33	1.20
Self-esteem	3.77	1.33	3.70	1.31
Self-continuity	4.52	1.00	3.66	1.06
Social connectedness	4.33	1.37	3.37	1.55
Meaning	4.31	1.47	3.81	1.39
Empathy	3.94	1.25	3.48	1.13
Time 3				
Positive Affect	3.76	1.09	3.70	1.20
Negative Affect	2.20	1.16	2.39	1.21
Self-esteem	3.67	1.32	3.57	1.29
Self-continuity	4.10	1.27	3.49	1.20
Social connectedness	3.88	1.38	3.22	1.48
Meaning	3.94	1.48	3.68	1.44
Empathy	3.64	1.33	3.50	1.15

Table 4.4

Descriptives and Reliabilities for the Time 1, Time 2, Time 3, Time 4, and Time 5 Measures for the Felt Nostalgia and Psychological Benefits (n = 136)

	α	*M*	*SD*
Time 1			
Felt Nostalgia	.98	4.87	1.92
Positive Affect	.91	3.98	1.44
Negative Affect	.91	2.06	1.45
Self-esteem	.92	3.75	1.44
Self-continuity	.82	4.10	1.55
Social Connectedness	.92	3.74	1.64
Meaning	.94	3.98	1.53
Empathy	.95	3.53	1.52
Time 2			
Felt Nostalgia	.99	2.87	1.72
Positive Affect	.93	3.65	1.50
Negative Affect	.92	2.15	1.39
Self-esteem	.96	3.58	1.44
Self-continuity	.93	3.73	1.58
Social connectedness	.95	3.40	1.70
Meaning	.98	3.75	1.62
Empathy	.98	3.27	1.55
Time 3			
Felt Nostalgia	.99	2.82	1.74
Positive Affect	.95	3.42	1.57
Negative Affect	.92	2.12	1.38
Self-esteem	.97	3.40	1.52
Self-continuity	.94	3.61	1.63
Social connectedness	.95	3.32	1.69
Meaning	.98	3.61	1.66
Empathy	.98	3.15	1.55
Time 4			
Felt Nostalgia	.99	2.63	1.78
Positive Affect	.95	3.34	1.56
Negative Affect	.95	2.19	1.47
Self-esteem	.97	3.38	1.54
Self-continuity	.94	3.56	1.65
Social connectedness	.96	3.23	1.70
Meaning	.98	3.46	1.69
Empathy	.98	3.06	1.58
Time 5			
Felt Nostalgia	.99	2.44	1.72
Positive Affect	.95	3.23	1.59
Negative Affect	.94	2.16	1.46
Self-esteem	.97	3.27	1.55
Self-continuity	.94	3.41	1.60
Social connectedness	.96	3.13	1.68
Meaning	.98	3.42	1.72
Empathy	.98	2.99	1.59

Table 4.5

Means And Standard Deviations Across Time-Points for the Felt Nostalgia Across the Experimental Conditions

Felt Nostalgia	Nostalgia $n = 68$		Control $n = 68$	
	M	*SD*	*M*	*SD*
Time 1	6.17	0.80	3.57	1.77
Time 2	3.31	1.82	2.42	1.45
Time 3	3.05	1.78	2.60	1.66
Time 4	2.80	1.83	2.45	1.68
Time 5	2.55	1.85	2.32	1.56

Table 4.6

Means And Standard Deviations Across Time Points for the Psychological Benefits Across the Experimental Conditions

Benefits of Nostalgia	Nostalgia n = 68		Control n = 68	
	M	*SD*	*M*	*SD*
Time 1				
Positive Affect	4.43	0.90	3.35	1.30
Negative Affect	1.88	1.01	2.24	1.36
Self-esteem	4.06	1.21	3.44	1.30
Self-continuity	4.75	1.05	3.46	1.11
Social connectedness	4.39	1.25	3.10	1.42
Meaning	4.44	1.16	3.51	1.50
Empathy	4.07	1.03	2.98	1.20
Time 2				
Positive Affect	3.99	1.03	3.30	1.45
Negative Affect	2.05	1.07	2.25	1.27
Self-esteem	3.89	1.29	3.26	1.38
Self-continuity	4.37	1.11	3.10	1.45
Social connectedness	4.06	1.31	2.75	1.59
Meaning	4.16	1.29	3.33	1.71
Empathy	3.73	1.17	2.82	1.42
Time 3				
Positive Affect	3.64	1.16	3.19	1.57
Negative Affect	2.12	1.11	2.12	1.24
Self-esteem	3.73	1.39	3.08	1.44
Self-continuity	4.09	1.26	3.12	1.58
Social connectedness	3.78	1.43	2.86	1.60
Meaning	3.83	1.48	3.39	1.71
Empathy	3.53	1.32	2.78	1.34
Time 4				
Positive Affect	3.43	1.21	3.26	1.57
Negative Affect	2.10	1.19	2.27	1.42
Self-esteem	3.55	1.44	3.20	1.48
Self-continuity	3.98	1.35	3.15	1.58
Social connectedness	3.57	1.43	2.89	1.70
Meaning	3.64	1.49	3.28	1.78
Empathy	3.37	1.32	2.75	1.45
Time 5				
Positive Affect	3.26	1.31	3.20	1.52
Negative Affect	2.13	1.29	2.18	1.28
Self-esteem	3.41	1.51	3.12	1.48
Self-continuity	3.78	1.43	3.05	1.44
Social connectedness	3.44	1.51	2.83	1.62
Meaning	3.53	1.56	3.32	1.78
Empathy	3.24	1.38	2.75	1.45

Table 4.7

Descriptives and Reliabilities for the Time 1, Time 2, Time 3, Time 4 and Time 5 Measures for the Felt Nostalgia and Psychological Benefits (n = 248)

	α	*M*	*SD*
Time 1			
Felt Nostalgia	.97	4.70	1.82
Positive Affect	.86	4.06	1.35
Negative Affect	.85	2.09	1.34
Self-esteem	.90	3.84	1.30
Self-continuity	.77	4.22	1.44
Social Connectedness	.91	3.93	1.59
Meaning	.91	4.21	1.43
Empathy	.94	3.76	1.40
Time 2			
Felt Nostalgia	.97	2.85	1.66
Positive Affect	.86	3.65	1.28
Negative Affect	.90	2.22	1.28
Self-esteem	.94	3.54	1.29
Self-continuity	.86	3.76	1.41
Social connectedness	.94	3.50	1.54
Meaning	.95	3.75	1.48
Empathy	.95	3.44	1.36
Time 3			
Felt Nostalgia	.98	2.57	1.60
Positive Affect	.88	3.48	1.33
Negative Affect	.86	2.20	1.24
Self-esteem	.94	3.41	1.30
Self-continuity	.89	3.64	1.45
Social connectedness	.94	3.40	1.53
Meaning	.96	3.66	1.55
Empathy	.96	3.30	1.40
Time 4			
Felt Nostalgia	.98	2.26	1.55
Positive Affect	.91	3.31	1.40
Negative Affect	.90	2.16	1.30
Self-esteem	.96	3.30	1.38
Self-continuity	.90	3.46	1.50
Social connectedness	.95	3.31	1.56
Meaning	.96	3.56	1.52
Empathy	.97	3.17	1.43
Time 5			
Felt Nostalgia	.97	2.17	1.53
Positive Affect	.91	3.25	1.44
Negative Affect	.90	2.18	1.31
Self-esteem	.96	3.30	1.43
Self-continuity	.91	3.40	1.52
Social connectedness	.94	3.29	1.58
Meaning	.96	3.50	1.55
Empathy	.96	3.09	1.44

Table 4.8

Means And Standard Deviations for the Felt Nostalgia and Psychological Benefits Across the Experimental Conditions

	VRT/Nostalgia *n* = 62		VRT/Control *n* = 62		ERT/Nostalgia *n* = 62		ERT/Control *n* = 62	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Time 1								
Felt Nostalgia	5.68	1.22	3.32	1.74	5.68	1.07	4.12	1.67
Positive Affect	4.25	1.01	3.94	0.98	4.18	0.82	3.86	1.24
Negative Affect	2.09	1.05	2.09	1.04	2.02	0.86	2.17	1.13
Self-esteem	3.73	1.13	3.77	1.21	3.88	1.07	3.96	1.15
Self-continuity	4.55	0.81	3.77	1.20	4.80	0.75	3.76	1.22
Social Connectedness	4.46	1.19	3.29	1.35	4.58	1.02	3.38	1.50
Meaning	4.22	1.26	4.05	1.20	4.33	1.20	4.27	1.44
Empathy	4.22	0.93	3.31	1.02	4.06	0.87	3.44	1.18
Time 2								
Felt Nostalgia	3.58	1.70	2.36	1.37	2.96	1.76	2.50	1.33
Positive Affect	3.86	0.95	3.45	0.84	3.70	1.00	3.60	1.10
Negative Affect	2.30	1.11	2.11	1.08	2.05	0.80	2.43	1.16
Self-esteem	3.60	1.17	3.24	1.20	3.62	1.16	3.71	1.20
Self-continuity	3.98	0.95	3.26	1.23	4.08	1.26	3.70	1.15
Social connectedness	3.94	1.23	2.91	1.32	3.93	1.26	3.22	1.57
Meaning	3.94	1.15	3.35	1.34	3.75	1.49	3.97	1.45
Empathy	3.76	1.00	2.98	1.02	3.70	1.09	3.33	1.16
Time 3								
Felt Nostalgia	3.16	1.58	2.03	1.29	2.59	1.72	2.49	1.44
Positive Affect	3.66	1.02	3.22	0.96	3.59	0.97	3.44	1.24
Negative Affect	2.23	0.89	2.17	0.99	2.12	0.92	2.26	1.03

	VRT/Nostalgia *n* = 62		VRT/Control *n* = 62		ERT/Nostalgia *n* = 62		ERT/Control *n* = 62	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Self-esteem	3.43	1.13	3.09	1.23	3.50	1.16	3.62	1.24
Self-continuity	3.75	1.05	3.25	1.34	4.02	1.26	3.56	1.24
Social connectedness	3.77	1.19	2.87	1.34	3.83	1.23	3.13	1.62
Meaning	3.72	1.31	3.27	1.47	3.82	1.46	3.83	1.59
Empathy	3.51	1.09	2.91	1.10	3.56	1.06	3.22	1.32
Time 4								
Felt Nostalgia	2.47	1.51	1.82	1.14	2.48	1.74	2.05	1.37
Positive Affect	3.34	1.13	3.27	1.12	3.30	1.14	3.33	1.33
Negative Affect	2.28	1.10	2.04	0.99	1.99	0.92	2.30	1.22
Self-esteem	3.36	1.13	3.08	1.35	3.31	1.35	3.44	1.35
Self-continuity	3.51	1.06	3.04	1.40	3.92	1.27	3.37	1.42
Social connectedness	3.64	1.31	2.77	1.40	3.72	1.36	3.09	1.61
Meaning	3.60	1.21	3.16	1.53	3.65	1.46	3.84	1.47
Empathy	3.36	1.16	2.83	1.13	3.37	1.14	3.14	1.38
Time 5								
Felt Nostalgia	2.06	1.35	1.76	1.14	2.42	1.80	2.42	1.52
Positive Affect	3.20	1.23	3.14	1.08	3.24	1.21	3.43	1.27
Negative Affect	2.33	1.14	2.25	1.04	1.92	0.92	2.23	1.18
Self-esteem	3.17	1.27	2.93	1.30	3.40	1.37	3.70	1.40
Self-continuity	3.43	1.22	2.92	1.40	3.82	1.41	3.42	1.25
Social connectedness	3.54	1.35	2.78	1.36	3.68	1.35	3.16	1.62
Meaning	3.38	1.30	3.15	1.50	3.62	1.52	3.85	1.50
Empathy	3.19	1.19	2.76	1.12	3.39	1.23	3.03	1.28

Figures

Figure 4.1

Time x Nostalgia (vs. Control) Interaction Effect on Felt Nostalgia

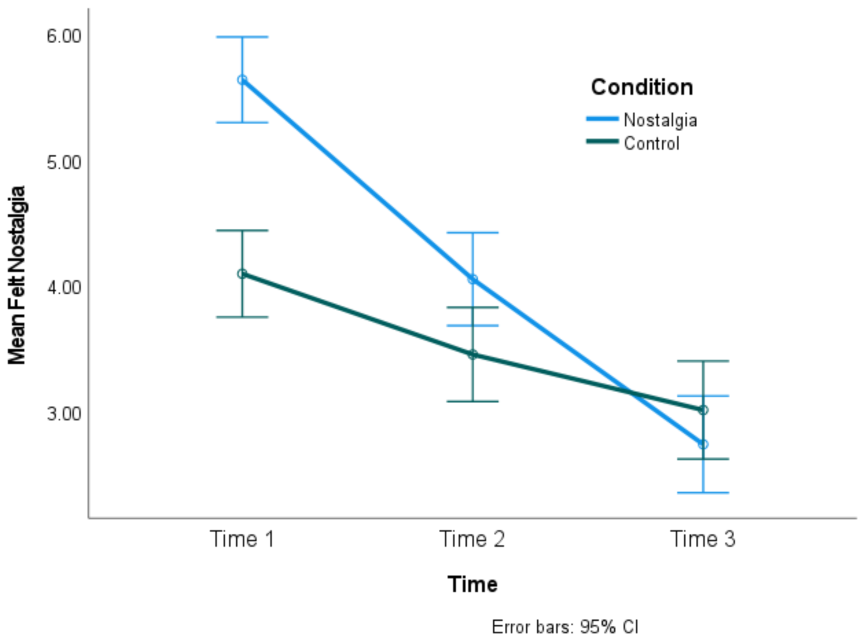
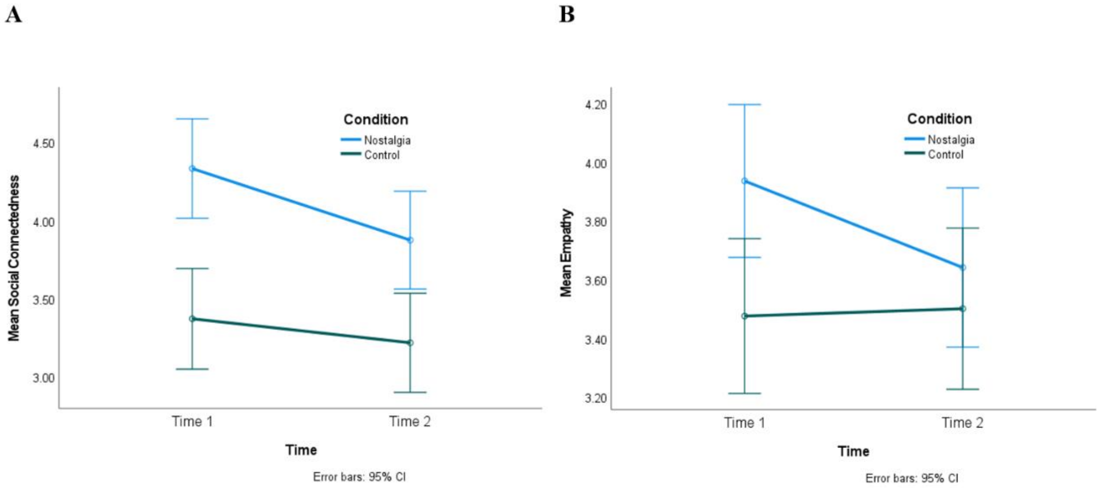


Figure 4.2

Time x Nostalgia (vs. Control) Interaction Effect on Social Connectedness and Empathy



Note. Panel A: The interaction between time and nostalgia (vs. control) on social connectedness. Panel B: The interaction between time and nostalgia (vs. control) on empathy.

Figure 4.3

Time x Nostalgia (vs. Control) Interaction Effect on Felt Nostalgia

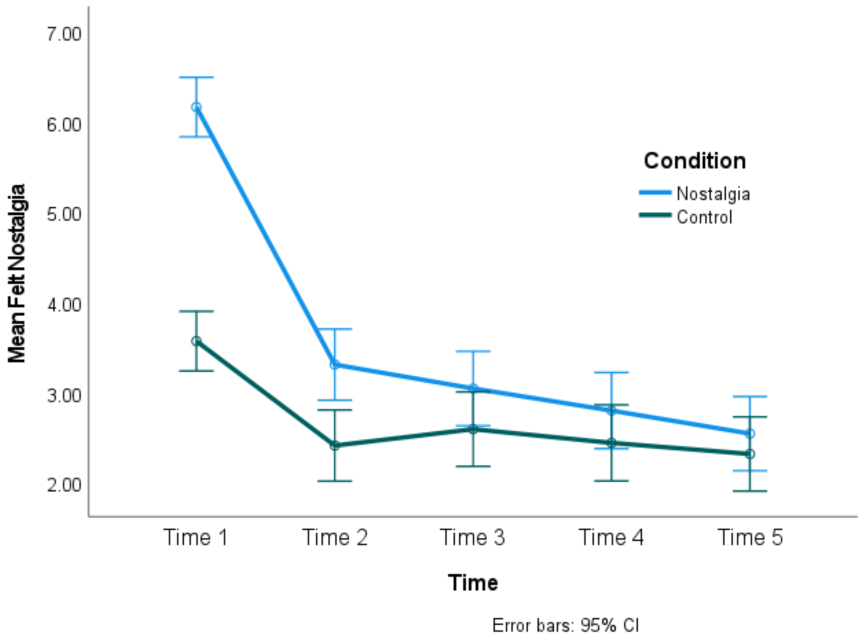
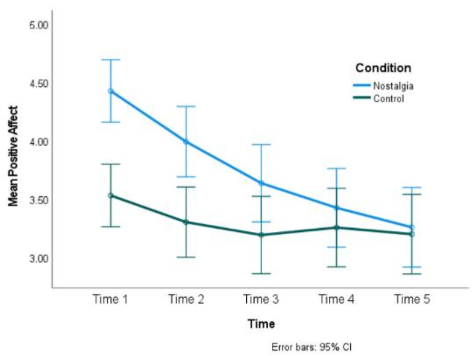


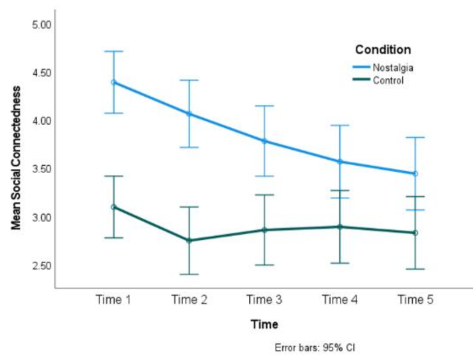
Figure 4.4

Time x Nostalgia (vs. Control) Interaction Effects on Psychological Benefits

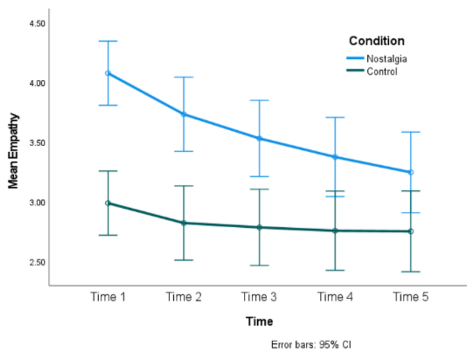
A



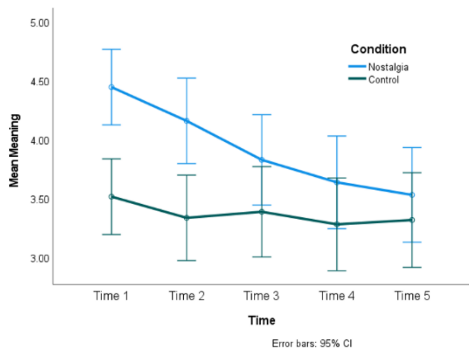
B



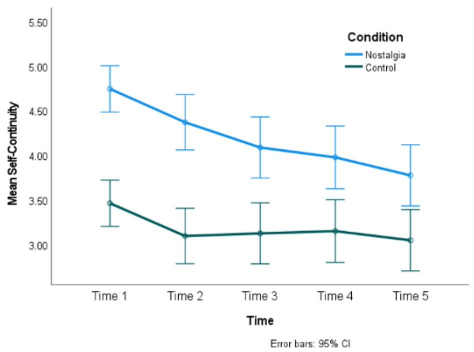
C



D



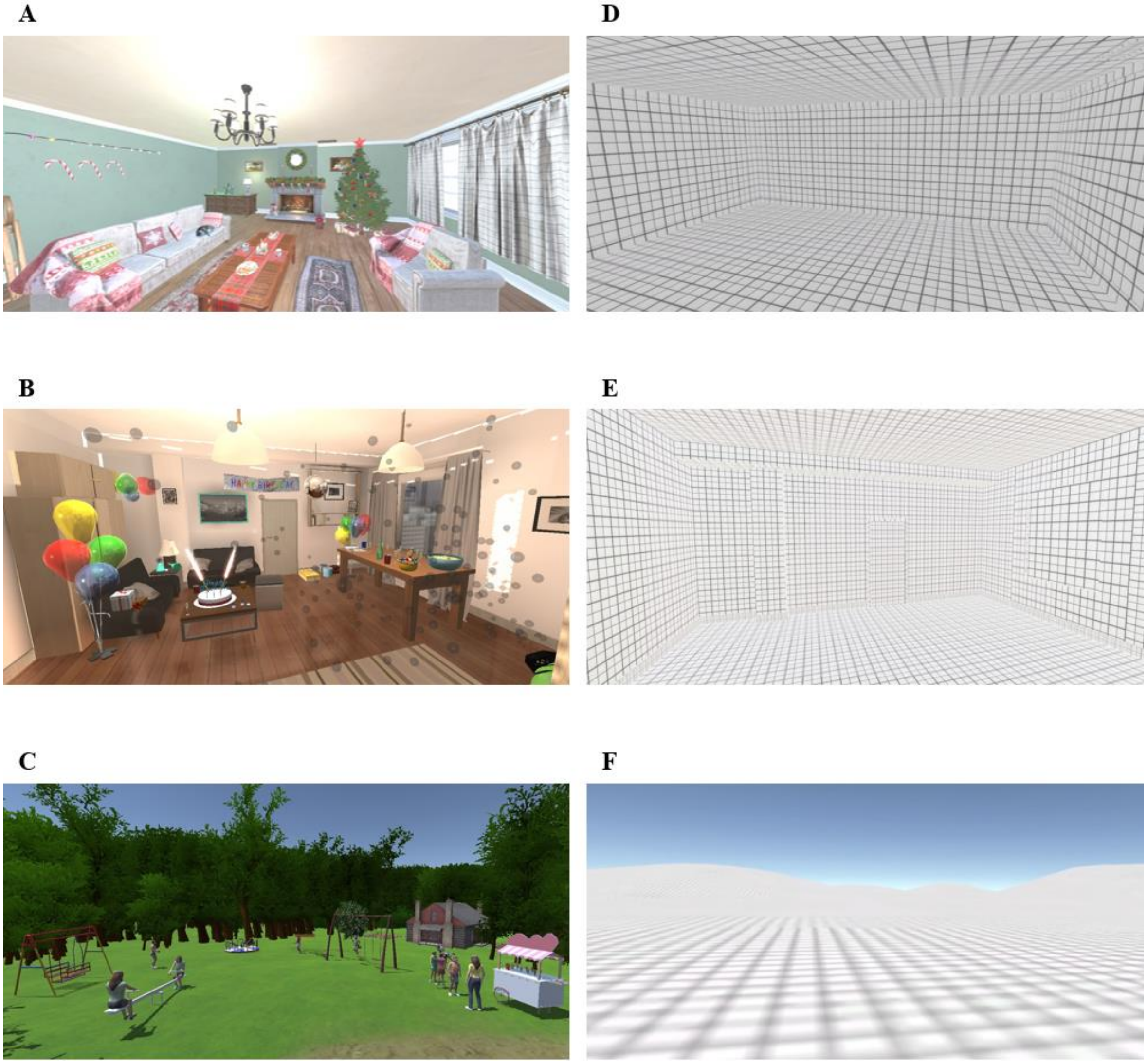
E



Note. Panel A: The interaction between time and nostalgia (vs. control) on positive affect. Panel B: The interaction between time and nostalgia (vs. control) on social connectedness Panel C: The interaction between time and nostalgia (vs. control) on empathy. Panel D: The interaction between time and nostalgia (vs. control) on meaning. Panel E: The interaction between time and nostalgia (vs. control) on self-continuity.

Figure 4.5

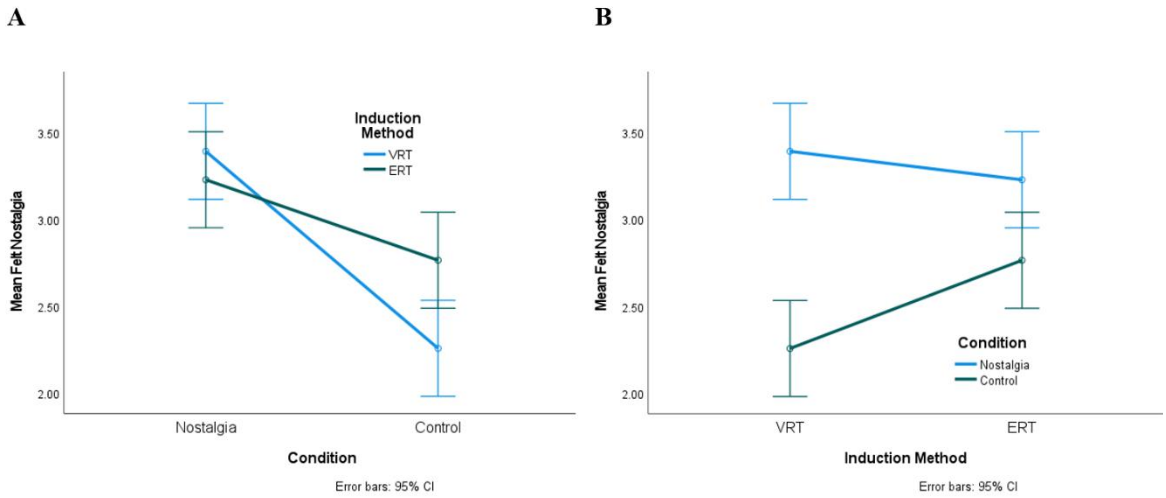
Example Scenes of VRT Induction



Note. Panel A: The three-dimensional virtual living room with a Christmas theme, including relevant objects such as a Christmas tree, and packed gifts. Panel B: The three-dimensional virtual living room with a birthday party theme, including relevant objects such as a birthday cake, and balloons. Panel C: The three-dimensional virtual children's playground, including relevant objects such as a swing, and a seesaw. Panel D: The three-dimensional empty virtual living room. Panel E: The three-dimensional empty virtual living room. Panel F: The three-dimensional empty virtual playground.

Figure 4.6

Induction Method x Nostalgia (vs. Control) Interaction Effect on Felt Nostalgia: Simple Effects

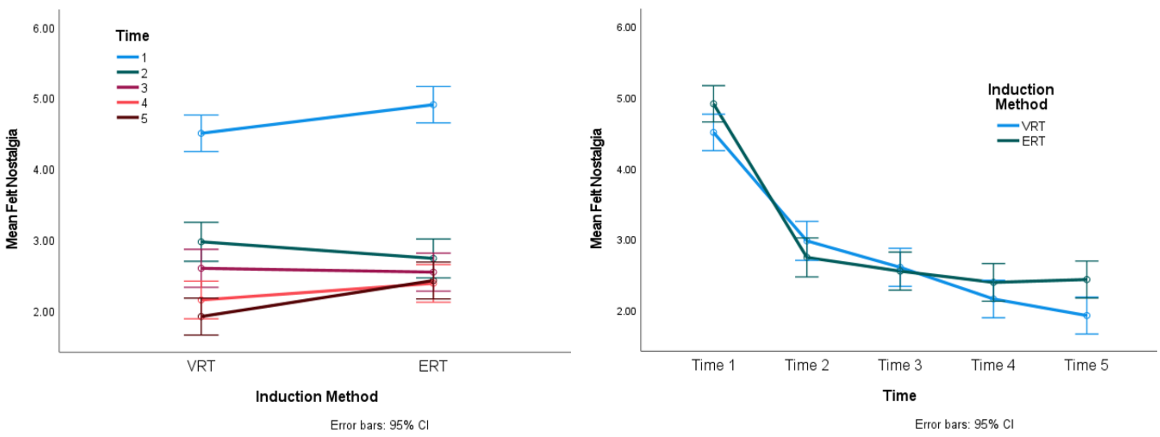


Note. Panel A: The test of simple induction method effects. Panel B: The test of simple condition effects.

Figure 4.7

Time x Induction Method Interaction Effect on Felt Nostalgia: Simple Effects

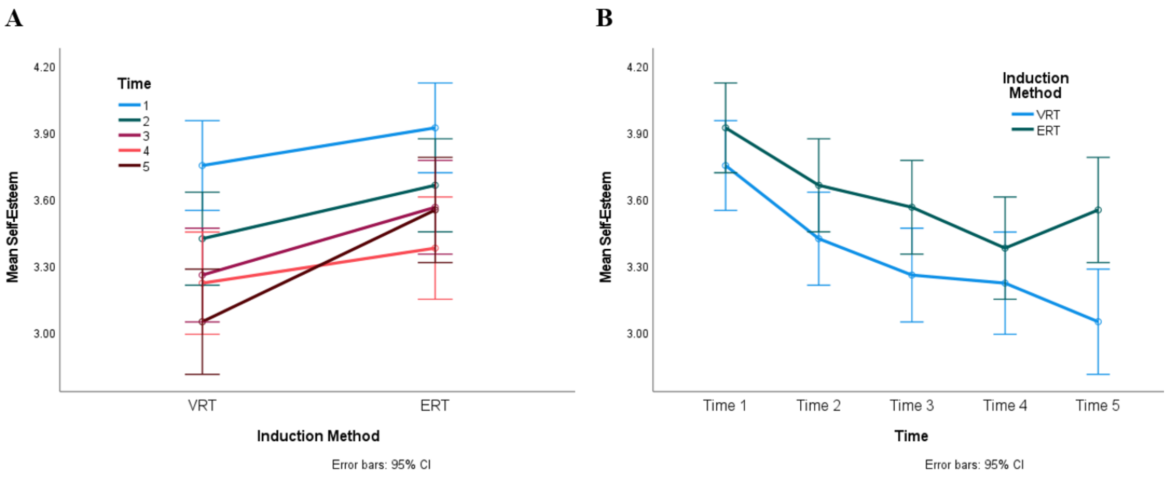
A B



Note. Panel A: The test of simple induction method effects. Panel B: The test of simple effects of time.

Figure 4.8

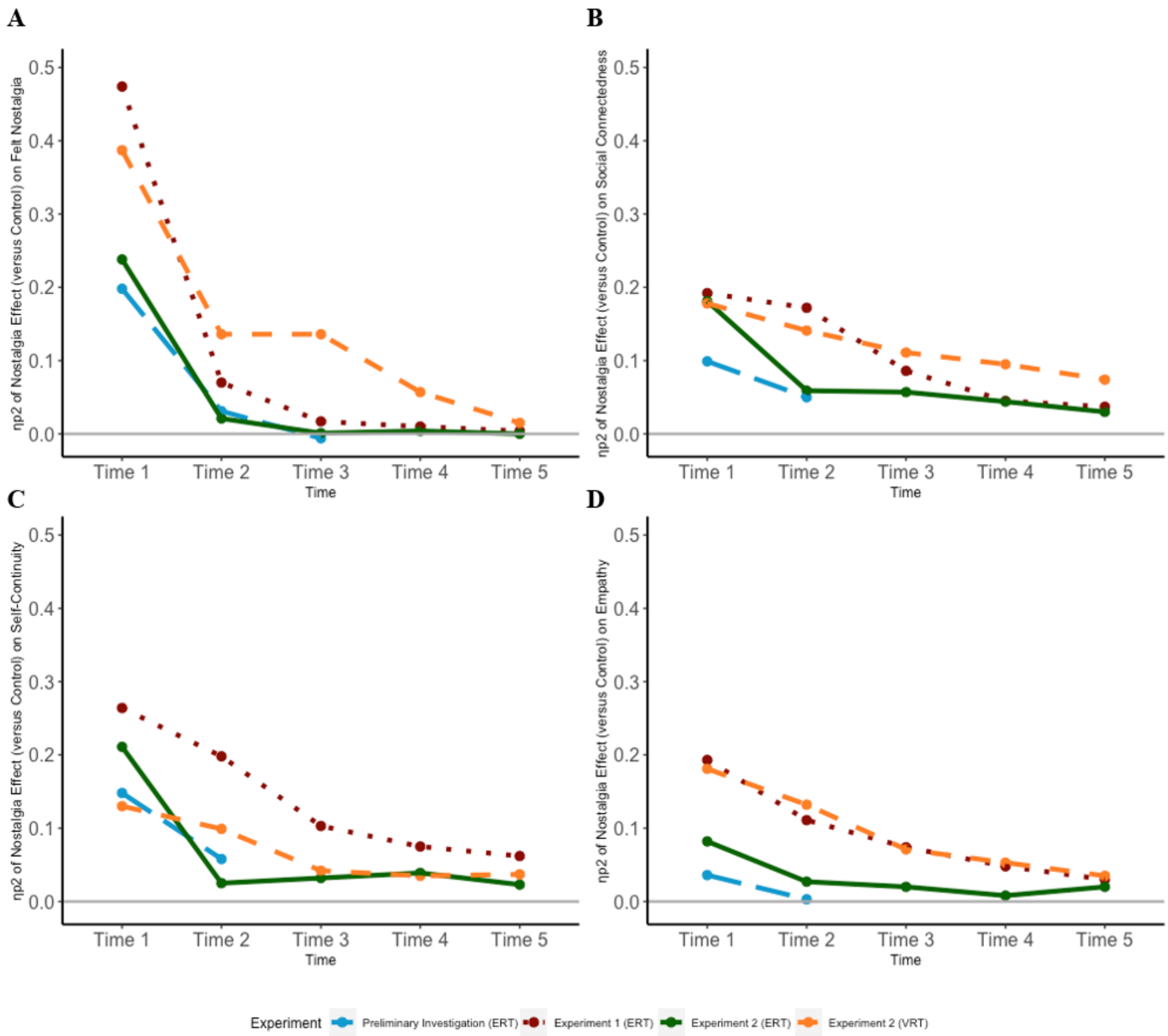
Time x Induction Method Interaction Effect on Self-Esteem: Simple effects



Note. Panel A: The test of simple effects of the induction method. Panel B: The test of simple effects of time.

Figure 4.9

Summary of Findings on the Temporal Change in Nostalgia (Compared to Control) Effect Over Time in Three Experiments



Note. η_p^2 is used to represent partial eta squared. The horizontal grey line corresponds to a score of zero on all graphs. In the preliminary investigation, felt nostalgia was measured at three time points, while social connectedness, self-continuity, and empathy were measured at two time points. Experiment 1 and Experiment 2 encompassed five time points. The graphs represent the temporal change in nostalgia (compared to control) effect on felt nostalgia (Panel A), social connectedness (Panel B), self-continuity (Panel C) and empathy (Panel D).

Chapter 5

General Discussion

The key purpose of this thesis was to investigate the correlational dynamics between nostalgia, empathy, attachment security, and emotional face categorisation, to evaluate different experimental induction methods including a novel VR-based nostalgia induction, and to explore the temporal variability of nostalgia. In this chapter, I will summarise the key findings of the studies that I presented in the previous chapters. Next, I will discuss the general strengths of this thesis followed by the possible practical and theoretical implications of my findings. I will then discuss the limitations and the recommendations for future studies. Lastly, I will complete this chapter with a general conclusion.

5.1 Summary of Key Findings

In Chapter 2, I presented two experiments that investigated the link between nostalgia, empathy, attachment security, and emotional face categorisation. Specifically, in Experiment 1, I sought to examine the potential relation between state and trait nostalgia, and emotional face categorisation, with cognitive, affective, and state empathy serving as mediators. I hypothesised that nostalgia, whether in a state or trait form, could impact facial emotion categorisation through the involvement of empathy, leading participants to be more sensitive to subtle variations in facial expressions. The results indicated that nostalgia proneness was related to greater empathy (state empathy, cognitive empathy, affective empathy). Nostalgia proneness was also related to a lower discrimination threshold for angry facial expressions, and the precision of responses at the threshold for angry and happy faces. Additionally, the results suggested that empathy (cognitive empathy and perspective-taking subscale) plays a mediating role in the relation between nostalgia proneness and sensitivity to the intensity of angry facial expressions (threshold). In Experiment 2, I aimed to evaluate the replicability of the findings from Experiment 1, evaluate empathic responses to face stimuli more directly through a novel Face Rating Task, and investigate whether attachment security could serve as an additional mediator in the relationship between nostalgia proneness and emotional face categorisation. The results indicated that nostalgia proneness was related to greater empathy (trait empathy, cognitive empathy, affective empathy, empathic accuracy), and attachment security. Nostalgia proneness was also related to the precision of responses at the threshold for angry facial expressions. Despite the identification of significant correlations, our theoretical assumption regarding the mediating influence of empathy or attachment security on the association between nostalgia proneness and emotional face categorisation did not receive empirical support. We could not replicate the mediational analysis outcomes observed in Experiment 1.

In Chapter 3, I presented an experiment that investigated a novel approach that could potentially offer a more effective and streamlined method for eliciting nostalgia in experimental settings. I put forth the proposition of utilising VR technology as a potential tool for inducing nostalgia, and aimed to explore whether the use of VR could offer a more intense and immersive nostalgic experience as compared to the ERT (Sedikides et al., 2015). Additionally, I aimed to explore the possibility that the psychological benefits associated with nostalgia could be more pronounced when employing VR as compared to ERT. I found that although the efficiency of VR-based nostalgia induction was not superior to ERT, it was effective in eliciting nostalgic feelings and demonstrated the ability to provide several psychological benefits, including heightened positive affect, strengthened sense of self-continuity, and enhanced social connectedness.

In Chapter 4, I presented two experiments that investigated the temporal changes in felt nostalgia and its psychological health benefits. In Experiment 1, I employed the ERT (Sedikides et al., 2015) to evoke nostalgia in an experimental context, and assessed the level of felt nostalgia, and its related psychological functions at five different stages during the course of the study. Upon analysis, I found that the impact of nostalgia induction on felt nostalgia disappeared after the second time point, specifically after a period of five minutes. Additionally, I found that various benefits of nostalgia, including self-continuity, social connectedness, and empathy, persisted until the end of the experiment, which spanned a duration of 20 minutes. In Experiment 2, I aimed to assess the replicability of the findings obtained in Experiment 1. Furthermore, I aimed to explore the efficacy of a novel nostalgia induction using VR, and compare its effectiveness to the ERT on the duration of felt nostalgia and its psychological functions. I found that there was a gradual linear decrease in the intensity of felt nostalgia and its associated psychological functions. Importantly, I found a significant interaction between Condition (nostalgia vs. Control) and Induction method (ERT vs. VRT) on felt nostalgia. The difference in felt nostalgia between the nostalgia and control conditions exhibited a stronger effect when nostalgia was induced through VRT as opposed to ERT. These findings imply that the employment of VRT as an induction method may potentially be more efficacious in augmenting the nostalgic experience when contrasted with ERT. The analysis also revealed no significant three-way interactions, suggesting that the two nostalgia induction methods (VRT vs. ERT) did not differ significantly in their ability to prolong the duration of felt nostalgia and its psychological functions. Lastly, I found that the influence of nostalgia manipulation on psychological functions such as self-continuity, social connectedness, and empathy remained significant until the fifth time point, which encompassed a period of 20 minutes. This effect was observed irrespective of the method used to induce nostalgia.

5.2 Implications

In the following paragraphs, I will discuss the broader implications of each of my empirical chapters. In brief, the thesis findings provide insights into how nostalgia is related to concepts such as empathy, attachment security, and emotional face categorisation, as well as how nostalgia is perceived and experienced in virtual and online environments. Consequently, the present findings have theoretical as well as practical implications that can be incorporated into future research.

The present thesis investigated the correlation between nostalgia, empathy, and facial emotion categorisation in Chapter 2, aiming to contribute to the literature by shedding light on the dynamics between these constructs. Understanding and interpreting emotional cues from others is crucial for effective social interactions on a daily basis (Montagne et al., 2007). Being able to comprehend accurately the emotions that others are expressing through their nonverbal cues can help individuals respond appropriately and empathetically, which can lead to better communication and stronger relationships (Schachner, Shaver & Mikulincer, 2005). On the other hand, empathy is a skill that allows social interaction and understanding the perspective of others in daily life (Calabria et al., 2009; Quinting et al., 2022). The relation between nostalgia and emotional face categorisation abilities suggested in Chapter 2, which is an essential way of understanding others' feelings, may aid in the understanding of how people process facial cues. This was a finding that could support the recommendation of treatment modalities that could be developed using nostalgia, for example, in psychological conditions involving disturbances in recognising emotion, or experiencing difficulties with empathy.

This thesis has contributed to the existing literature on nostalgia by introducing an innovative method of nostalgia induction through VR. With the procedure using VR to evoke nostalgia described in Chapter 3, the present thesis introduced pioneering findings regarding the creation of highly personalised nostalgic experiences through the use of customisable virtual environments. These environments have the potential to be tailored to the unique preferences and memories of individual users, thereby enhancing the degree of personalisation and immersion achievable in such experiences (Heyse et al., 2020). VR also enables individuals to re-live past experiences in a controlled and immersive environment (Diniz Bernardo et al., 2021; Lindner et al., 2017; Wilson & Soranzo, 2015).

Therefore, the use of VR can be particularly beneficial for people who have difficulty recalling or recounting their personal memories, such as dementia patients. In such instances, the use of VR technology to evoke nostalgic experiences as a form of therapeutic intervention presents a potentially promising avenue for exploration. Additionally, VR-based nostalgia manipulation could potentially be utilised as a therapeutic tool to enhance mental well-being and tackle real-world issues such as loneliness and lack of self-continuity.

Finally, the present thesis provided an opportunity to compare the online and laboratory settings in terms of the duration of felt nostalgia and its psychological functions. In particular, the present findings suggest that nostalgia could have important practical implications. It was discovered in Chapter 4 that the psychological benefits of nostalgia, including social connectedness, self-continuity, and empathy, can endure for a longer period of time following a nostalgia elicitation. Based on these results, experiencing sustained self-continuity, social connectedness, and empathy may lead to improved long-term psychological well-being (Routledge et al., 2012), and their sustained impact following nostalgia induction may have implications for improving long-term psychological health. For example, increased and sustained social connectedness may provide a range of positive outcomes, including better physical and mental health, by fostering stronger social relationships (Holt-Lunstad, Smith & Layton, 2010; Sedikides et al., 2015). Additionally, having prolonged empathy through nostalgia induction may also promote long-term well-being by encouraging individuals to connect with others and engage in prosocial behaviours (Zhou et al., 2012). As a longitudinal intervention, scheduled nostalgia inductions might be integrated into individuals' lives, ensuring regular exposure to activities designed to evoke nostalgic memories. Additionally, these interventions might be designed to be personalised, considering individual differences in responses and tailoring approaches to specific needs. Overall, by leveraging these constructs through nostalgia-based interventions, practitioners may be able to help individuals build resilience, cope with adversity, and improve their overall quality of life.

5.3 Strengths, Limitations and Future Directions

5.3.1 Strengths

In Chapter 2, I theorised and tested the link between nostalgia and emotional face categorisation, and found the relation between those constructs with the mediation of empathy. Although past research has demonstrated the link between nostalgia and empathy (Zhou et al., 2012; Cheung et al., 2017; Juhl et al., 2020; Newman et al., 2020), and empathy and emotional face discrimination (Hess & Blairy, 2001; Andréasson & Dimberg, 2008; Balconi & Bortolotti, 2013; Balconi & Canavesio, 2016), no research has addressed the overall link together. I focused on this in Chapter 2, and thereby provided novel insights into the relation between nostalgia, empathy, and face categorisation.

Another strength of the present thesis is that I integrated a technological tool (VR) into the nostalgia literature by presenting a novel nostalgia induction method. Previously, researchers used autobiographical recall methods for nostalgia induction, such as the ERT (Sedikides et al., 2015), and methods that used external triggers of nostalgia (e.g. music, Barrett et al., 2010; scents, Reid et al., 2015). As was discussed in the previous chapters, VR is considered an effective tool for mood/emotion induction given its potential to provide great flexibility and control over the environment (Wilson & Soranzo, 2015; Freeman et al., 2017; Lindner et al., 2021). Based on this, I proposed a technique that employs VR, and I tested its efficacy in eliciting nostalgic feelings via several virtual environments (Holak & Havlena, 1992). In conclusion, I have presented a useful and repeatable experimental method.

An additional strength of my thesis is that I employed a variety of methodological approaches. To illustrate, in the nostalgia and face categorisation paper, I measured nostalgia and empathy using different measures to make it robust against the variations.

Additionally, I both used two self-report measurements (i.e. QCAE and IRI) and a face rating task that I created to measure empathy. That approach allowed the measuring of empathic behaviour besides the information that was provided by the self-report measurements. Furthermore, in Chapters 2 and 4, I used online and laboratory-based experimental settings to provide diversity.

5.3.2 Limitations and Future Directions

The findings of Experiments 1-2, reported in Chapter 2, were mixed. Although the findings of Experiment 1 demonstrated significant correlations and mediational pathways, Experiment 2 did not replicate these findings. Additionally, attachment security did not emerge as a mediator in this relationship as suggested. Numerous factors may have contributed to this lack of consistent findings. One factor may relate to the experimental settings used. Whereas I collected the data for Experiment 1 in a laboratory setting, the Experiment 2 data were collected online. For the online experiment, I instructed participants to use the Card Task and the Blind Spot Task (Li et al., 2020) to adjust the size of the facial stimuli as well as their own distance from the screen. However, I had no control over whether participants made these necessary adjustments prior to the face discrimination and face rating tasks. A second factor may be related to the face discrimination and face rating tasks used. Although I intended to present facial emotions in a way that could be encountered in real life, I used a morphing algorithm to adjust the intensity of the emotions, which could have resulted in unrealistic facial expressions. Future studies may take the presented results as a baseline, and investigate the hypotheses further with different facial stimuli in an environment that provides full control.

A further limitation concerns the new VR induction technique. With this induction, I provided virtual images that were not specifically tailored for each participant. Instead, I created three virtual environments (i.e. a room involving Christmas-related items, a room with a birthday theme, and a children's playground) based on studies that explored the content of nostalgia, and expected them to trigger nostalgic memories for most (but perhaps not all) participants. Based on the findings, the method that I created was successful in evoking nostalgic feelings. However, when I compared two distinct induction methods (VRT vs. ERT), VRT did not consistently outperform ERT. Further studies can evaluate the effectiveness of personalised virtual environments. For example, it would be interesting to explore the effectiveness of personalised VRT induction as an intervention method for specific diagnoses, such as dementia. Additionally, when considering enhancing the personalisation, immersion and realism of virtual environments, the use of 360° cameras (i.e., panoramic or omnidirectional cameras) would be a feasible solution. These cameras can capture indoor or outdoor scenes, using dense depth map estimation (Im et al., 2016), structure-from-motion methods (Song et al., 2018), and scene reconstruction methods (Kim & Hilton, 2013; Kim et al., 2020 have enabled researchers to streamline both simple set-up and capture processes, and dynamic scene captures from real life (Kim et al., 2022). Moreover, Kim et al. (2022) presented a viable approach for recreating realistic audio-visual VR scenes based on 360° images, enabling spatial audio adaptation to the virtual representation of a room environment. Further studies may use omnidirectional cameras to tailor virtual environments based on one's autobiographical event, which may both increase the personalisation, immersion and realism of the scenes, and create a more impactful VR induction of nostalgia.

An additional limitation of the current research relates to the duration of the nostalgia inductions. For example, in Chapter 4, I explored the duration of nostalgic feelings by experimentally eliciting nostalgia through either VRT or ERT for five minutes. I demonstrated that these inductions increased felt nostalgia immediately following participants' exposure to them. However, these induction effects on felt nostalgia dissipated rather quickly. Relatedly, research has shown a significant correlation between the length of the emotion-eliciting event and the emotional response (Frijda, 2007; Moors, Ellsworth, Scherer & Frijda, 2013; Verduyn et al., 2009). Future studies may evaluate how induction time influences the duration of nostalgia by implementing longer nostalgia inductions.

Finally, before generalising the findings, one must consider that participants were predominantly university students. Wildschut et al. (2006) provided evidence on the frequency of nostalgia by surveying British undergraduates and asking them to report how often they recall nostalgic memories, the majority of participants stated that they experience nostalgia at least once a week. However, the prevalence of nostalgic experiences shows variation across individuals in correlation with their respective age groups. Turner and Stanley (2021) conducted a study measuring the daily occurrence of nostalgia over a span of two weeks within the demographic groups of young adults, middle-aged adults, and older adults. The findings indicated that young adults were 60% less inclined to report experiencing nostalgia compared to middle-aged adults, whereas older adults were three times more prone than middle-aged adults to report nostalgic feelings. Based on this, future studies should consider recruiting participants from a broader sample with different demographic characteristics.

5.4 General Conclusion

This thesis takes several different approaches toward nostalgia. Specifically, I focused on the relationship between nostalgia and emotional facial categorisation, the creation of a new nostalgia induction method using VR, and the duration of nostalgia and its psychological benefits in an experimental environment. In the first empirical paper, I provided evidence regarding the association between nostalgia proneness and emotional face categorisation mediated by empathy. However, those findings were not supported by Experiment 2. In the second empirical paper, I assessed the efficacy of VR as a nostalgia induction technique, and presented evidence that the VR induction was successful. Finally, in the third empirical paper, I explored the duration of nostalgia and its psychological benefits, and I compared two induction methods (VRT vs. ERT) in terms of their impact on the duration of felt nostalgia and its psychological benefits. I found that, although felt nostalgia faded swiftly, various functions provided by nostalgia, including social connectedness, empathy, and self-continuity, lasted until the end of the experiment. Together, these findings provided intriguing evidence for the wide-ranging psychological benefits of nostalgia, and have laid the groundwork for future researchers to integrate VR technology into their designs.

Appendix A Materials used in Chapter 2

A.1 The Event Reflection Task Instructions

Nostalgia condition

According to the Oxford Dictionary, 'nostalgia' is defined as a 'sentimental longing for the past.' Please think of a nostalgic event in your life. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel? Using the space provided below, for the next few minutes, we would like you to write about the nostalgic event. Immerse yourself into this nostalgic experience. Describe the experience and how it makes you feel.

Please write down four keywords relevant to this nostalgic event (i.e., words that describe the experience). Keywords that describe your nostalgic experience:

Control Condition

Please bring to mind an ordinary event in your life. Specifically, try to think of a past event that is ordinary. Bring this ordinary experience to mind. Immerse yourself in the ordinary experience. How does it make you feel? Using the space provided below, for the next few minutes, we would like you to write about the ordinary event. Immerse yourself into this nostalgic experience. Describe the experience and how it makes you feel.

Please write down four keywords relevant to this ordinary event (i.e., words that describe the experience). Keywords that describe your ordinary experience:

A.2 Questionnaires

Southampton Nostalgia Scale

According to the Oxford Dictionary, 'nostalgia' is defined as a 'sentimental longing for the past.' Indicate your answer by using the scale below.

1 = Not at all, 7 = Very much

1. How valuable is nostalgia for you?
2. How important is it for you to bring to mind nostalgic experiences?
3. How significant is it for you to feel nostalgic?
4. How prone are you to feeling nostalgic?

1 = Very rarely, 7 = Very frequently

5. How often do you experience nostalgia?
6. Generally speaking, how often do you bring to mind nostalgic experiences?
7. Specifically, how often do you bring to mind nostalgic experiences? (Please check one.)

   _____ At least once a day

   _____ Three to four times a week

   _____ Approximately twice a week

   _____ Approximately once a week

   _____ Once or twice a month

   _____ Once every couple of months

   _____ Once or twice a year

Past Positive Scale

Please read each statement carefully and, as honestly as you can, answer the following question: "How characteristic or true is this of you?" Indicate your answers by using the rating scale presented below. Please select a number rating with each statement.

1 = Very uncharacteristic – 7 = Very characteristic

1. It gives me pleasure to think about my past.
2. I get nostalgic about my childhood.
3. Happy memories of good times spring readily to mind.
4. On balance, there is much more good to recall than bad in my past.
5. I enjoy stories about how things used to be in the "good old times."
6. Familiar childhood sights, sounds, and smells often bring back a flood of wonderful memories.
7. I like family rituals and traditions that are regularly repeated.

Nostalgia Proneness Index

Please respond to the questions below, using the following scales.

1 = I do this rarely, 7 = I do this very often

1 = This is not important to me, 7 = This is very important to me

1. I bring to mind rose-tinted memories.
2. I reflect on keepsakes.
3. I long for a time or place from my past.
4. I remember shared experiences with my family and friends.
5. I remember my childhood.

Manipulation Check

The following statements refer to how you feel right now. Please indicate your agreement or disagreement by using the scale below.

1 = Strongly disagree – 7 = Strongly Agree

1. Right now, I am feeling quite nostalgic.
2. Right now, I am having nostalgic feelings.
3. I feel nostalgic at the moment.

The state-level empathy scale

Reflect back on the event you previously described during this experiment. Please indicate how thinking about this event makes you feel, using the scale below.

"Thinking about this event ..."

1 = Strongly disagree, 6 = Strongly agree

1. makes me feel sympathetic
2. makes me feel compassionate
3. makes me feel softhearted
4. makes me feel tender
5. makes me feel warm
6. makes me feel moved
7. makes me feel sympathy for the less fortunate
8. makes me feel compassionate for the fate of others
9. makes me feel empathy for the less fortunate
10. makes me feel tenderness for the less fortunate
11. makes me feel warm toward the less fortunate
12. makes me feel moved towards the plight of others

The Questionnaire of Cognitive and Affective Empathy

Below is a list of statements. Please read each statement carefully and rate the extent to which you feel or would act this way RIGHT NOW, using the scale presented below. There are no right or wrong answers or trick questions. Please answer each question as honestly as you can.

1 = Strongly disagree, 4 = Strongly agree

1. I sometimes find it difficult to see things from the “other guy’s” point of view.
2. I am usually objective when I watch a film or play, and I don’t often get completely caught up in it.
3. I try to look at everybody’s side of a disagreement before I make a decision.
4. I sometimes try to understand my friends better by imagining how things look from their perspective.
5. When I am upset at someone, I usually try to “put myself in his shoes” for a while.
6. Before criticizing somebody, I try to imagine how I would feel if I was in their place.
7. I often get emotionally involved with my friends’ problems.
8. I am inclined to get nervous when others around me seem to be nervous.
9. People I am with have a strong influence on my mood.
10. It affects me very much when one of my friends seems upset.
11. I often get deeply involved with the feelings of a character in a film, play, or novel.
12. I get very upset when I see someone cry.
13. I am happy when I am with a cheerful group and sad when the others are glum.
14. It worries me when others are worrying and panicky.
15. I can easily tell if someone else wants to enter a conversation.
16. I can pick up quickly if someone says one thing but means another.
17. It is hard for me to see why some things upset people so much.

18. I find it easy to put myself in somebody else's shoes.
19. I am good at predicting how someone will feel.
20. I am quick to spot when someone in a group is feeling awkward or uncomfortable.
21. Other people tell me I am good at understanding how they are feeling and what they are thinking.
22. I can easily tell if someone else is interested or bored with what I am saying.
23. Friends talk to me about their problems as they say that I am very understanding.
24. I can sense if I am intruding, even if the other person does not tell me.
25. I can easily work out what another person might want to talk about.
26. I can tell if someone is masking their true emotion.
27. I am good at predicting what someone will do.
28. I can usually appreciate the other person's viewpoint, even if I do not agree with it.
29. I usually stay emotionally detached when watching a film.
30. I always try to consider the other fellow's feelings before I do something.
31. Before I do something I try to consider how my friends will react to it.

The Interpersonal Reactivity Index

For each item, indicate how well it describes you by using the scale below.

1 = Does not describe me well, 5 = Describes me very well

1. I daydream and fantasize, with some regularity, about things that might happen to me.
2. I often have tender, concerned feelings for people less fortunate than me.
3. I sometimes find it difficult to see things from the "other guy's" point of view.
4. Sometimes I don't feel very sorry for other people when they are having problems.
5. I really get involved with the feelings of the characters in a novel.
6. In emergency situations, I feel apprehensive and ill-at-ease.
7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it.
8. I try to look at everybody's side of a disagreement before I make a decision.
9. When I see someone being taken advantage of, I feel kind of protective towards them.
10. I sometimes feel helpless when I am in the middle of a very emotional situation.
11. I sometimes try to understand my friends better by imagining how things look from their perspective.
12. Becoming extremely involved in a good book or movie is somewhat rare for me.
13. When I see someone get hurt, I tend to remain calm.
14. Other people's misfortunes do not usually disturb me a great deal.
15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.
16. After seeing a play or movie, I have felt as though I were one of the characters.
17. Being in a tense emotional situation scares me.
18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them.
19. I am usually pretty effective in dealing with emergencies.
20. I am often quite touched by things that I see happen.
21. I believe that there are two sides to every question and try to look at them both.
22. I would describe myself as a pretty soft-hearted person.
23. When I watch a good movie, I can very easily put myself in the place of a leading character.
24. I tend to lose control during emergencies.

25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while.
26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.
27. When I see someone who badly needs help in an emergency, I go to pieces.
28. Before criticizing somebody, I try to imagine how I would feel if I were in their place.

The Attachment Style Questionnaire

Please indicate the extent to which you agree with the following statements.

1 = Strongly disagree, 5 = Strongly agree

1. I feel at ease in emotional relationships.
2. I avoid close ties.
3. I trust other people and I like it when other people can rely on me.
4. I feel uncomfortable when relationships with other people become close.
5. I find it easy to get engaged in close relationships with other people.
6. I feel at ease in intimate relationships.
7. I think it is important that people can rely on each other.
8. I trust that others will be there for me when I need them.

Appendix B Materials used in Chapter 3

B.1 The Virtual Reality Task Instructions

Nostalgia condition

According to the Oxford Dictionary, 'nostalgia' is defined as a 'sentimental longing for the past'. Please think of a nostalgic event in your life related to the environment that you are experiencing now. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel? For the next 7 to 10 minutes, you will speak about the nostalgic event while looking around the environment. When you are ready, you can start describing your memory and how it makes you feel.

After you finish describing your nostalgic memory, please say four keywords relevant to this nostalgic event (i.e., words that describe the experience). Keywords that describe your nostalgic experience:

Control condition

Please think of an ordinary event in your life related to the environment that you are experiencing now. Specifically, try to recall an ordinary memory from your past that happened outside/at home. Bring this ordinary memory in mind and immerse yourself in the ordinary experience. How does it make you feel? For the next 7 to 10 minutes, you will speak about the ordinary event while looking around the environment. When you are ready, you can start describing your memory and how it makes you feel.

After you finish describing your ordinary memory, please say four keywords relevant to this ordinary event (i.e., words that describe the experience). Keywords that describe your ordinary experience:

B.2 The Event Reflection Task Instructions

Nostalgia condition

According to the Oxford Dictionary, 'nostalgia’ is defined as a 'sentimental longing for the past.’ Please think of a nostalgic event in your life. Specifically, please think of a nostalgic event in your life related to A) Christmas Holiday or B) your childhood. Bring this nostalgic experience to mind. Using the space provided below, for the next few minutes, we would like you to write about the nostalgic event. Immerse yourself into this nostalgic experience. Describe the experience and how it makes you feel.

Please write down four keywords relevant to this nostalgic event (i.e., words that describe the experience). Keywords that describe your nostalgic experience:

Control condition

Please bring to mind an ordinary event in your life (i.e. an ordinary event that happened outside or at home). Specifically, try to think of a past event that is ordinary. Bring this ordinary experience to mind. Immerse yourself in the ordinary experience. How does it make you feel? Using the space provided below, for the next few minutes, we would like you to write about the ordinary event. Immerse yourself into this nostalgic experience. Describe the experience and how it makes you feel.

Please write down four keywords relevant to this ordinary event (i.e., words that describe the experience). Keywords that describe your ordinary experience:

B.3 Questionnaires

Manipulation Check

The following statements refer to how you feel right now. Please indicate your agreement or disagreement by using the scale below.

1 = Strongly disagree – 7 = Strongly Agree

1. Right now, I am feeling quite nostalgic.
2. Right now, I am having nostalgic feelings.
3. I feel nostalgic at the moment.

The state-level empathy scale

Reflect back on the event you previously described during this experiment. Please indicate how thinking about this event makes you feel, using the scale below.

"Thinking about this event ..."

1 = Strongly disagree, 6 = Strongly agree

1. makes me feel sympathetic
2. makes me feel compassionate
3. makes me feel softhearted
4. makes me feel tender
5. makes me feel warm
6. makes me feel moved
7. makes me feel sympathy for the less fortunate
8. makes me feel compassionate for the fate of others
9. makes me feel empathy for the less fortunate
10. makes me feel tenderness for the less fortunate
11. makes me feel warm toward the less fortunate
12. makes me feel moved towards the plight of others

Psychological Benefits of Nostalgia

Reflect back on the event you previously described during this experiment. Please indicate how thinking about this event makes you feel, using the scale below.

"Thinking about this event ..."

1 = Strongly disagree, 6 = Strongly agree

1. makes me feel happy
2. puts me in a good mood
3. makes me feel active
4. makes me feel ecstatic
5. makes me feel calm
6. makes me feel relaxed
7. makes me feel unhappy
8. makes me feel sad
9. makes me feel disturbed
10. makes me feel upset
11. makes me feel tired
12. makes me feel sluggish
13. makes me feel good about myself
14. makes me like myself better
15. makes me value myself more
16. makes me feel I have many positive
17. makes me feel connected with my past
18. makes me feel connected with who I was in the past
19. makes me feel that there is continuity in my life
20. makes me feel like important aspects of my personality remain the same across time

21. makes me feel connected to loved ones
22. makes me feel protected
23. makes me feel loved
24. makes me feel I can trust others
25. makes me feel life is meaningful
26. makes me feel life has a purpose
27. makes me feel there is a greater purpose to life
28. makes me feel that life is worth living

Appendix C Materials used in Chapter 4

C.1 The Virtual Reality Task Instructions

Nostalgia condition

According to the Oxford Dictionary, 'nostalgia' is defined as a sentimental longing for the past. Please think of a nostalgic event in your life related to the virtual scene that you chose. Specifically, try to think of a past event that makes you feel most nostalgic regarding the virtual environment that you are in now. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel? For the next five minutes, we would like you to talk about the nostalgic event while looking around. Immerse yourself in this nostalgic experience. Describe the experience in detail and how it makes you feel. Please push the button on the controller and start describing your nostalgic memory.

Please say four keywords relevant to this nostalgic event (i.e., words that describe the experience). Keywords that describe my nostalgic experience:

Control condition

Please bring to mind an ordinary event (everyday, regular) in your life. Specifically, try to think of an event that is ordinary. Bring this ordinary experience in mind. Immerse yourself in the ordinary experience. How does it make you feel? For the next five minutes, we would like you to talk about the ordinary event while looking around. Immerse yourself into this ordinary experience. Describe the experience in detail and how it makes you feel. Please push the button on the controller and start describing your ordinary memory.

Please say four keywords relevant to this ordinary event (i.e., words that describe the experience). Keywords that describe my ordinary experience:

C.2 The Event Reflection Task Instructions

Nostalgia condition

According to the Oxford Dictionary, 'nostalgia' is defined as 'a sentimental longing for the past.' Please think of a nostalgic event in your life related to either (a) Christmas Holiday, (b) your childhood, or (c) one of your past birthdays. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this nostalgic experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel?

Using the space provided below, for the next five minutes, we would like you to write about the nostalgic event. Immerse yourself into this nostalgic experience. Describe the experience in detail and how it makes you feel. (A submit button will appear after five minutes.)

Please write down four keywords relevant to this nostalgic event (i.e., words that describe the experience). Keywords that describe my nostalgic experience:

Control Condition

Please bring to mind an ordinary event in your life (i.e. an ordinary event on the university campus or a day at home). Specifically, try to think of an event that is ordinary. Bring this ordinary experience in mind. Immerse yourself in the ordinary experience. How does it make you feel?

Using the space provided below, for the next five minutes, we would like you to write about the ordinary event. Immerse yourself into this experience. Describe the experience in detail and how it makes you feel. (A submit button will appear after five minutes.)

Please write down four keywords relevant to this ordinary event (i.e., words that describe the experience). Keywords that describe my ordinary experience:

C.3 Filler Task

Attentional tasks

Summarise the last book you read.

Describe the stages of planting a seed.

Describe the stages of cooking pasta.

List the names of as many countries as you can.

List the names of as many plants as you can.

List the names of as many animals as you can.

Basic mathematical problem

19 + ? = 67 - Please write the answer below.

90 - 18 = ? - Please write the answer below.

(2 + 3) + 118 = ? - Please write the answer below.

190 – 87 + 16 = ? - Please write the answer below.

200 – (96 / 4) = ? - Please write the answer below.

(6 + 3 x 8) – 5 = ? - Please write the answer below.

1 = 4, 2 = 16, 3 = 64, 4 = ? - Please write the answer below.

23 x 23 = ? - Please write the answer below.

9 x 87 = ? - Please write the answer below.

3, 5, 8, 13, 21, ? - Please write the answer below.

Anagrams

Identify the anagram: "Pairs" - Which city could it be?

Identify the anagram: "Salvages" - Which city could it be?

Identify the anagram: "Asia Ultra" - Which country could it be?

Identify the anagram: "Diagnose" - Which city could it be?

Identify the anagram: "Opera Sing" - Which country could it be?

Identify the anagram: "Enemy" - Which country could it be?

Identify the anagram: "Ink Pasta" - Which country could it be?

Identify the anagram: "Touch Safari" - Which country could it be?

Identify the anagram: "Salad Lover" - Which country could it be?

Identify the anagram: "Newt Lizards" - Which country could it be?

Multiple-choice questions

Which is a synonym of indomitable? Unbeatable, Inconceivable, Excitable, Limited

Which is a synonym of stymie? Repair, Loathe, Partake, Impede

Which is a synonym of verboten? Proscribed, Majestic, Inexpensive, Latent

Which is a synonym of exiguous? Meager,Dissonant, Individual, Luxuriant

Which is a synonym of pelagic? Repugnant, Capacious, Taciturn, Oceanic

Which is a synonym of flotsam? Debris, Eccentricity, Chasm, Whim

Which is a synonym of empirical? Debatable, Friendly, Provable, Mirky

Which is a synonym of refulgence? Concordance, Luminance, Vengeance, Stygian

Which is a synonym of disabuse? Boycott, Undeceive, Treat, Exaggerate

Which is a synonym of instigate? Bask, Provoke, Spread, Improve

Which is a synonym of aggrandize? Glorify, Exhaust, Excavate, Pour

C.4 Questionnaires

Manipulation Check

The following statements refer to how you feel right now. Please indicate your agreement or disagreement by using the scale below.

1 = Strongly disagree – 7 = Strongly Agree

1. Right now, I am feeling quite nostalgic.
2. Right now, I am having nostalgic feelings.
3. I feel nostalgic at the moment.

Psychological Benefits of Nostalgia

Reflect back on the event you previously described during this experiment. Please indicate how thinking about this event makes you feel, using the scale below.

"Thinking about this event ..."

1 = Strongly disagree, 6 = Strongly agree

1. makes me feel happy
2. puts me in a good mood
3. makes me feel active
4. makes me feel ecstatic
5. makes me feel calm
6. makes me feel relaxed
7. makes me feel unhappy
8. makes me feel sad
9. makes me feel disturbed
10. makes me feel upset
11. makes me feel tired
12. makes me feel sluggish

13. makes me feel good about myself
14. makes me like myself better
15. makes me value myself more
16. makes me feel I have many positive
17. makes me feel connected with my past
18. makes me feel connected with who I was in the past
19. makes me feel that there is continuity in my life
20. makes me feel like important aspects of my personality remain the same across time
21. makes me feel connected to loved ones
22. makes me feel protected
23. makes me feel loved
24. makes me feel I can trust others
25. makes me feel life is meaningful
26. makes me feel life has a purpose
27. makes me feel there is a greater purpose to life
28. makes me feel that life is worth living
29. makes me feel sympathetic
30. makes me feel compassionate
31. makes me feel softhearted
32. makes me feel tender
33. makes me feel warm
34. makes me feel moved
35. makes me feel sympathy for the less fortunate
36. makes me feel compassionate for the fate of others
37. makes me feel empathy for the less fortunate

38. makes me feel tenderness for the less fortunate

39. makes me feel warm toward the less fortunate

40. makes me feel moved towards the plight of others

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The references below are for Chapters 1 & 5. Relevant references can be found at the end of Chapter 2, Chapter 3 and Chapter 4.

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