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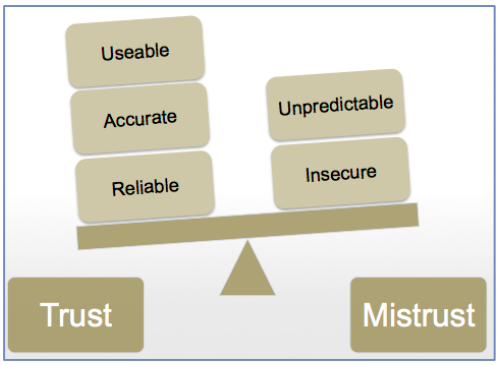
[Document structure]

1. Executive summary
2. Aims, objectives and methods
3. Key findings
4. Key issues
5. Next steps
6. Engagement and impact
7. Additional outputs
8. Dissemination
9. Funding
10. References
11. Appendices

Executive Summary of TRIFoRM: TRust in IT: Factors, metRics, Models

TRIFoRM brought together computer science, health science, social science and engineering to explore the trusting beliefs of users of IT systems, looking at factors that influence individual trust of systems and ways to model those factors and trust levels. The TRIFoRM team, based across three different faculties at the University of Southampton, focused particularly on healthcare technologies for monitoring chronic conditions.



During the project, the team brought together existing theoretical work on trust, before interviewing people who may use or provide healthcare monitoring technology to understand what was important to them as individuals. Analysis of the interviews let the team identify possible threats to trust of the technology and controls to mitigate those threats.

Two major threats were identified. The first is User Disengagement – if the medical team don't adopt the technology, then patients will lose interest in that technology. The second is an Unusable System – causing all users, clinicians as well as patients, to lose interest and disengage. User Disengagement can be mitigated with appropriate training and support; Unusable System can be helped with appropriate design expertise.

The team also identified two key issues. Firstly, it is clear that people using a monitoring technology to manage pain are more likely to take risks and tolerate faults: this means that those people are more vulnerable than otherwise. This has clear implications for the need to be cognisant of user motivation and application domain when designing this kind of system. The second issue is the importance of relationships. The people we interviewed who might use monitoring technology were concerned about whether such technology might change their relationship with healthcare providers, as well as with whether healthcare providers themselves trust the technology.

The team didn't only read literature, interview people and analyse results. TRIFoRM took a talk, poster and demo to the ITaaU Community Conference (Southampton, 6-7 July 2015), connecting with a wide range of conference participants with whom the team remains in touch. The team has provided inputs to a number of projects, most notably OPTET (a large EU project that models system trust and trustworthiness) and RApp (a national project that is developing a smartphone app for sufferers of rheumatoid arthritis to monitor pain), but also four other projects. The TRIFoRM team is keen to continue its work, and has already identified several sources of funding suitable for doing this, and other partners who may contribute to the work.

Aims, Objectives and Methods

The TRIFoRM (TRust in IT: Factors, metRics, Models) pilot project explored the trusting beliefs of individual users of IT systems. Whereas the EU OPTET project (http://www.optet.eu/) is conducting methodologies to create more trusted and trustworthy systems, TRIFoRM aimed to address a significant gap by looking specifically at how users develop and apply trust to these systems. As such, TRIFoRM would provide OPTET with additional models to be able to determine when user trust is out of balance with system trustworthiness, adding to the set of warnings or reassurances that can be provided by the system to administrators as well as users. As such, this will help users benefit from systems that are aware of trust issue, and therefore safe and secure, protecting users from risks should systems be compromised by attackers or by internal errors.

OPTET infers user trust based on a model predicting how trust levels will change as a result of a user's experiences when interacting with a system that is usually but not always trustworthy. This model is sufficient to support the IT system engineering goals of OPTET, but does not capture what users really feel about IT systems, or how those feelings affect their use of such systems. TRIFoRM addresses this gap. Instead of conceptualising trust as solely a response to system behaviour, TRIFoRM investigated a more holistic model, with two objectives:

1) Identify factors that influence individual trust of IT systems
2) Identify ways to model and measure levels of trust and changes in these levels

In order to scope the project appropriately, TRIFoRM focused on the domain of monitoring technologies for the management of chronic pain. The method taken follows:

1) A state of the art was assembled from the social sciences
2) The state of the art was analysed to identify factors to be accounted for
3) Semi-structured interviews were held with two stakeholder groups (service users, and service providers), guided by the outputs of steps (1) and (2)
4) A thematic analysis of the semi-structured interviews was conducted, yielding two thematic maps
5) Analysis of the thematic maps led to identification of threats not covered by OPTET
6) The newly-identified threats were formally modelled, along with controls to mitigate the threats.

Key Findings

Key outputs were: the state of the art; the thematic analysis of the semi-structured interviews (including two thematic maps); the newly-identified threats and controls.

State of the art: available in full in Appendix I: State of the Art, this interdisciplinary literature review brings together over 70 key publications considering the topics of defining trust, theoretical foundations of trust in technology models, trust models, trust in technology, the Technology Acceptance Model, and finally the formation of trust in technology.

Thematic analysis: available in full in Appendix II: Thematic Analysis of Interview Responses, this text describes the approach taken to the TRIFoRM interviews with service users and the service provider, particularly the way in which the interviews were structured based on the state of the art. The analysis presents thematic maps of the four major themes

that were revealed by the analysis: technology acceptance, human-computer interactions, trust transfer, and demographics. Key insights include that service users who are engaged with the service to manage pain are more likely to take risks and tolerate faults, while trust transfer is an important construct that shows how human-to-human interactions can strongly influence human-to-technology trust. In sum, trust in the healthcare environment seems to be a complex interaction between the utility and convenience of that technology as it affects and supports existing human interaction. It is also about enhancing and developing the human-to-human interaction, saving time for quantitative or ill-remembered information gathering to allow for more effective and mutually satisfying human-to-human interaction. The technology should be an enhancement to and not a replacement for such interaction.

Newly-identified threats and controls: available in full in Appendix III: Risk Models and Controls Added to OPTET, the thematic analysis let us identify two new threats that were not covered by the OPTET model. First is User Disengagement, whereby clinician disengagement undermines the trust of pain sufferers, causing the latter to lose interest in engaging with the system. Second is Unusable System, a possible cause of clinician disengagement whereby a person finds the system unusable and disengages from it. Controls to mitigate these two threats were also identified, and consist of User Training (for the User Disengagement threat) and HCI Analysis (for the Unusable System threat).

The modelling of threats and controls in the OPTET style positions us to take metrics of user trust in systems, by measuring occurrence and control of such threats.

Key Issues

Key issues we identified are the importance of:

- motivation and domain (and the impact of these on ethical aspects)
- human and organisational relationships

The topic of motivation and domain relates to the insight that service users seeking to manage pain are more risk- and fault-tolerant, meaning that they are potentially more vulnerable than otherwise. Clearly, IT utilities intended to support users in this way must be designed, implemented, tested and maintained in a way that is cognisant of this issue.

The topic of human and organisational relationships relates to trust transfer and patient concern that monitoring technology might change their relationship with health care providers. There was concern that patients might lose contact with practice nurses if nurses start spending time checking data, not patients. There was also concern that consultants might not look at the data, in which case patients would not trust or use the system that created it. This shows that user trust in the IT system depends somewhat on user interactions outside the system, particularly whether the presence of the IT system changes expectations or behaviour (or both) in those direct user-to-user relationships.

Next Steps

The TRIFoRM team has identified several sources of funding for next steps:

1. Web Science Institute Stimulus funding: a source of money for small interdisciplinary projects, this is an ideal way to continue the partnership we began with the RApp project (more on this below) and gather substantial data from people trialling a technology for healthcare monitoring.
2. EPSRC call on trust, identity, privacy and security: this £4-7m call, to be launched in August 2015, seeks user-driven, interdisciplinary research projects in areas including trust and security. EPSRC seek research ideas with potential beneficiaries, meaning the call is ideal for a large-scale follow-up project involving the original TRIFoRM team and additional partners such as the AECC (more on this below).

In addition, the TRIFoRM team will shortly make contact with a number of participants from the ITaaU Community Conference who expressed an interest in the project, including but not limiting those specified in the 'Dissemination' section below.

Engagement and Impact

TRIFoRM had impacts on study participants, the OPTET project, and a related project.

Study participants: the study participants, both service users and service provider, expressed interest in the results of TRIFoRM. They will shortly receive a news-style summary.

The OPTET project partners are now in the process of adding the newly-identified threats and controls from TRIFoRM to their existing model, augmenting it to reflect these findings.

The Rheumatoid Arthritis App (RApp) project seeks to develop a smartphone app for both objective and subjective monitoring of rheumatoid arthritis (objective: monitoring physical movements; subjective: patient reports of pain levels). RApp and TRIFoRM have been in contact for some months now, and RApp partners expressed an interest in TRIFoRM findings, which will be shared with them.

Additional Outputs

TRIFoRM directly contributed to two bids for funding, had implications for four projects (besides OPTET and RApp) and led to two possible collaborators.

Funding: knowledge gained from TRIFoRM contributed directly to two recent bids, 5G-ENSURE (which was won) and SavingFood (awaiting evaluation). Both proposals relate to user engagement with sensitive technical components and so benefited from the detailed understanding of the development of user trust, especially in machine-mediated interactions.

Projects:

1. eVACUATE: user responses to technology, both evacuees and operational staff
2. HUMANE: how trust relations might affect human-machine networks
3. PRICE: how trust relations might affect social machines in general and TimeBanks in particular
4. ProSocialLearn: how trust relations may translate to co-operation in the virtual world.

Collaborators:

1. Dave Newell from the Anglo-European Chiropractic College (AECC) was extremely interested in and supportive of TRIFoRM. The TRIFoRM team hope to involve Dave in future collaborations.
2. Alex Forrester and Jimmy Caroupapoulle (University of Southampton) are involved in the Rheumatoid Arthritis App project, and expressed interest in collaboration with TRIFoRM. This was not possible during TRIFoRM due to different project timescales, but the TRIFoRM team hope to involve Alex and Jimmy in future collaborations.

Dissemination

The TRIFoRM team produced three blog posts throughout the project[1], making the project aims and outcomes accessible to a broad audience.

TRIFoRM was well represented at the ITaaU Community Conference, held in Southampton on 6 - 7 July 2015. A lightning talk outlining the goals, methods and outcomes of TRIFoRM was given; this was followed by a poster and demo (showing the process of modelling TRIFoRM risks with OPTET technology). This was successful, with a high number of visitors to the TRIFoRM exhibit. Contacts that resulted include (but are not limited to):

- Mary Keane-Dawson: a technology evangelist involved in healthcare technologies, who wants to stay in touch with TRIFoRM-related developments.
- David Rew: a surgeon who came to similar conclusions as TRIFoRM regarding the possible risks of healthcare technology on clinician-patient interactions.
- Ashok Ranchhod: a researcher working on children's engagement with their medical treatment, and hence very interested in how trust of technology can be established.
- Pat Langdon, a researcher working in AI and robotics, who was very interested to learn about the key constructs in the TRIFoRM literature.

Funding

The TRIFoRM team currently plan two consecutive bids, as described in the 'Next Steps' section above.

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McKnight, D.H., Carter, M., Thatcher, J.B. & Clay, P.F. (2011) Trust in specific technology: An investigation of its components and measures. *ACM Transactions on Management Information Systems.*

Söllner, M., Hoffmann, A., Hoffmann, H., Wacker, A. & Leimeister, J. M. (2012) Understanding the Formation of Trust in IT Artifacts. *Internationaöl Conference on Information Systems.* Orlando Florida.

[1] The first is online at http://www.itutility.ac.uk/2014/10/30/trust-in-it-factors-metrics-models/. At the time of writing, the second two are due to be posted online shortly.
[2] See end of appendices for all references.

Appendix I: State of the Art on Factors that Influence Individual Trust or Mistrust of IT Systems

Recent years have seen a significant increase in the use of healthcare technologies. Uses for these technologies cover a broad spectrum from devices that diagnose specific conditions or deliver specific treatments to those that remotely monitor people's conditions away from the hospital environment. The potential benefits from such technologies are considerable (Bruining et al., 2014). First, they offer the promise of better treatment through the provision of more precise diagnosis of conditions and less invasive procedures (e.g. (Chau and Hu, 2002, Curry, 2007)). Second, they may act as workforce multipliers, performing basic tasks and freeing clinical staff for other activities (Ortega Egea and Roman Gonzalez, 2011). Third, they may alter the nature of consultations for example by limiting time taken to measure symptoms so allowing more time to spend talking about potential deeper issues of a patient's care. Alternatively they may enable the time spent with patients in consultations to be reduced or eliminate the need for some consultations altogether thus increasing the efficiency of organisational resources (Boehm, 2003, Ferguson, 2000) and lowering health costs (Kassirer, 2000, Malcolm, 2001).

The impact of technologies in this context therefore has the potential for wide-ranging effects on both patients and the workforce and in doing so raises questions about the varying perceptions of costs and benefits amongst these different stakeholders (Waytz et al., 2014, Bruining et al., 2014, Montague and Asan, 2012, Xin et al., 2012, Li et al., 2008, McKnight et al., 2011b). Innovation brings with it risk and potential vulnerability and it becomes important to consider issues such as whether these technologies are trusted by various users to perform their task, whether they will deliver the sort of care that people want, whether they will disrupt patient-service user relationships and whether they may threaten existing professional work roles by changing the nature of work (Prichard et al., 2014, Montague, 2010).

Addressing questions around trust in new healthcare technologies is important as there is a substantial body of knowledge to show that trust is correlated with the adoption and ongoing use of new technologies (Madhavan and Wiegmann, 2007, Bruining et al., 2014, Montague et al., 2009, McKnight et al., 2011b, Söllner et al., 2012). Where trust in a technology is low people may fail to adopt it, they might limit their reliance on it so negating potential benefits, or they may use it in unintended ways with the potential to negatively impact on care quality. If we can understand the key factors that impact on trust we can think about how to design and implement technologies in such a way as to gain and maintain trust at appropriate levels (Madhavan and Wiegmann, 2007, Langfred, 2004, Lee and See, 2004).

This literature review considers the factors that influence individual levels of trust in IT systems. First is defines trust drawing on the most universally accepted understanding of the concept. It then considers how models of trust, originally developed in the context of human to human (H2H) relationships, have been incorporated into conceptualisations of trust between humans and technological systems. From this we critically review prominent models of trust and of trust in technology in particular in order to identify the key influencing factors in the development of trust in technology.

Defining trust

The concept of *trust* has been defined in many different ways in the literature (Cheshire, 2011, Colquitt et al., 2007, Corritore et al., 2003, Grimmelikhuijsen and Meijer, 2012, Henderson and Gilding, 2004, Lewicki et al., 2006, Li, 2007, Pettit, 2008, Rousseau et al., 1998). Although often conflated with *trustworthiness* (Cheshire, 2011, Colquitt et al., 2007), which is a perceived characteristic of the person or thing to be trusted, there is some consensus surrounding the core themes used by researchers to define trust (Lewicki et al., 2006). For example, there is now more widespread agreement of the importance of confident expectations about the trustee, as well as the willingness of the trustor to risk making themselves vulnerable to the actions of others, based on an expectation of a positive outcome (e.g. (Colquitt et al., 2007, Li, 2007, Rousseau et al., 1998, Mayer et al., 1995a)). These core themes are very much at the heart of Mayer et al.'s (1995) widely used definition of trust. In their model they propose that trust can be defined as *'the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party'* (p.712). Although Mayer et al.'s definition was based around trust in dyads, it has since been utilised successfully across many different domains including teams, organisations and importantly in relation to this project, to technology (e.g., Ashleigh and Prichard, 2012, Lewicki et al., 2006, Li et al., 2008, McKnight et al., 2011b).

Despite Mayer et al.'s (1995) definition of trust being utilised across a broad section of research, some scholars have questioned whether the characteristics of human trusting beliefs can be applied to trust in technology (Söllner et al., 2012, Friedman et al., 2000). They propose that as technology has no volition (i.e. no choice or will as to whether to behave in particular ways), it cannot be considered as a subject of trust. However, McKnight et al. (2011) refute this proposition, arguing that consistent with trust between humans, trust in technology exists under contextual conditions involving risk, uncertainty and lack of total user control. Their premise is that even though technology lacks moral agency – the will to choose between right and wrong

- this doesn't mean to say that the concept of trust is irrelevant. For example, a car has no free will about whether to start, yet we trust (or don't) that it will work when we want to use it. Therefore, trust in technology reflects a trustor's belief in the technology's characteristics such that it will function as expected, whilst at the same time accepting vulnerability to system failures. From this position many researchers have relied on definitions of trust such as Mayer et al.'s whilst adapting them so that they are more appropriate to the target of trust. For example, Xin et al. (2012) define trust in technology as *people's beliefs regarding the trustworthiness of particular IT to perform a task* (p.18).

Theoretical foundations of trust in technology models

Theoretical frameworks of trust in technology have also evolved from models of trust between humans (e.g., Lewicki and Bunker, 1996, Li et al., 2008, Mayer et al., 1995b). However, as with definitions of trust, a parallel debate exists about the appropriateness of applying human to human (H2H) models of trust to human to technology relationships (H2T). On one side of the debate, researchers argue that IT systems are social actors (Li et al., 2008, Nass et al., 1997) and can mirror characteristics similar to humans such as personality and language structures (Madhavan and Wiegmann, 2007). Furthermore, human operators respond socially to IT as they would to other humans, ascribing personal attributes such as politeness, personality and attractiveness and have been found to view them as team mates (Wang and Emurian, 2005, Nass and Lee, 2001). Such findings have been used as a basis by some to argue that models of H2H trust and the factors believed to underpin the decision to trust can be applied to explain people's trust in technology (Li et al., 2008, McKnight and Chervany, 2001b).

In contrast, other scholars regard trust in technology as being different. They suggest that despite attributing human qualities to technologies, there are subtle differences in our reactions to them in relation to trust (Madhavan and Wiegmann, 2007). For example, research examining trust in human versus computer decision systems has found that people perceive expert computer systems as more objective and rational than human systems and are more likely to trust this advice even when they have more accurate information from human advisors (Dijkstra, 1999). Other research has found that although evidence exists that computerised expert systems are more credible sources of information than humans, this trust may be more fragile (Madhavan and Wiegmann, 2007). (Dzindolet et al., 2002) for instance found that some users of technology possess what has been termed a perfect automation schema (PAS) – a set of beliefs in automated systems that a technology will not fail. Such strong expectations can lead users to overreact to system errors resulting in a

substantial reduction in trust. The same research found that in contrast to trust in a technology, people are comparatively more tolerant of errors made by other humans whose fallibility seemed more accepted and had much less impact on trust. These and other findings suggest that people trust technology differently to the way in which they trust in humans. Consequently, whilst we would not agree that interpersonal models should necessarily be rejected as a basis for understanding trust in a technology, different or adapted models may also be required in order to develop a more comprehensive understanding of trust in technology (Li et al., 2008, McKnight et al., 2011b, Montague, 2010, Söllner et al., 2012). It may be acceptable to borrow models of trust from humans in order to measure trust in technology as long as we can adapt them to be relevant towards the characteristics of IT artefacts themselves.

Models of trust in technology might also need to include a consideration of the context in which a technology is operating and the nature of the trust network (Prichard et al., 2014). For example, whether the technology exists as an endpoint to achieve a task or whether it acts between a user and some type of service provider (Söllner et al., 2012, Madhavan and Wiegmann, 2007, Montague et al., 2009) . These issues become relevant as they may signal the need to consider trust not just in terms of the features of the system itself but also how that system relates to some wider aspect of service provision and the risks to the user in that context. For example in relation to healthcare, the costs of a technology that fails can be very high. A patient is not just a user of the technology but is also the data source that the technology is acting on by measuring some aspect of that patients condition (Montague et al., 2009). Consequently, trust may take on a particular salience in this setting because vulnerability is high and multifaceted. Similarly, the embedded nature of a technology in the wider system of a patient's care might result in trust in a technology being determined in part by a service users beliefs about their clinician or of the organisation providing their care. Models of trust in technology might therefore also need to be sensitive to the influence of the wider socio-technological context (Montague et al., 2009, Montague, 2010, Montague et al., 2013, Prichard et al., 2014).

Trust models

In terms of citations, Mayer's integrative model has provoked the most interest and study[3] (Mayer et al., 1995a), and so certainly deserves review. Figure 1 provides an overview.

[3] By June 2015, *Google Scholar* states that it has received 11280 citations, which works out at approximately 560 citations per year over the twenty years since publication.

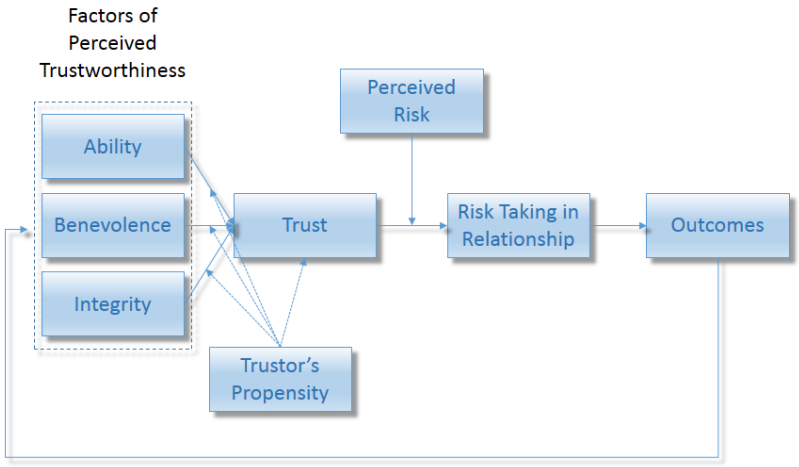


Figure 1: Integrative Model of Organizational Trust after Mayer, Davis and Schoorman, 1995

Mayer et al. set out explicitly to review one individual's trusting behaviours towards another as they are relevant to an individual's trust in an organisation (op.cit., p709). Based on a meta-analysis of related, relevant work, they suggest three inter-related though independent constructs. To begin with, there is *ability*, or the domain-specific set of skills and characteristics which enable an individual (or organisation presumably) to "have influence", in their terms, or to be capable of achieving something in more general terms (op.cit., p718). They add to this the concept of *benevolence*, or the objective of a party to see beyond their own self-interest and genuinely seek the good of the trustor (op.cit., p718f); and then *integrity*, which is the perception that the other party complies with a set of criteria which the trustor finds acceptable (op.cit., p719f).

Mayer et al (1995) then consider *risk taking*, risk being an essential part of trust in terms of behavioural response, rather than any particular willingness to accept vulnerability, which may be seen as cognitive or affective aspects of trust as a whole (op.cit., p724ff). Although not explicitly shown in the model itself (*q.v.*), the authors nevertheless claim that *context* – the dynamically changing perception of political, social and economic climate – will also have a pervasive effect on the evaluation of trustworthiness as well as risk taking (op.cit., p726f). To this end, the temporal (re-)evaluation of responses or *outcomes* to the trusting behaviours is the final relevant component of the overall model (op.cit., p727f).

Subsequent reflection, as well as a review of related research, led Schoorman et al. (2007) to acknowledge a number of limitations of the original model in which it ignored. For example, they acknowledge that initially the model deliberately avoided issues of:

- *relationships*, which may operate on a one-to-one as well as institutional level; I may trust my GP, for example, but not the surgery as a whole (Schoorman et al., 2007, p344f);
- *reciprocal behavioural changes*, and *directionality* : if my GP consistently gets my name wrong, then I may begin to lose trust; or if I am trusted to monitor my own diet, I may engage more readily with what they suggest (op.cit., p347);
- that there was a requirement for a *clarification of time*: as I get older, I may begin to trust my GP more (op.cit., p346);
- a need to introduce notions of *affect*: I may not like my GP, and this could affect how I respond to her/his diagnoses (op.cit., p348);
- *violation and repair*: if my GP makes a mistake, and then does what they can to apologise and recover the situation, I may develop a more accepting stance to future issues (op.cit., p349),
- *cross-cultural*: my GP and I may not share the same cultural ideas around intimate relationships (op.cit., p350) and
- *context-specific modifications*: I may be desperate for palliative care, even though, my medical condition will not improve (op.cit., p351).

Nevertheless, Schoorman et al. (2007) claim that the model is still applicable, and remains a parsimonious and generalizable one (op.cit., p352).

Many of the modifications and extensions Schoorman et al. (2007) identified relate to important constructs and paradigms in social psychology. Issues of relationship construction, violation and repair, cross-culture and even context-specificity can linked to social constructivist models (Gergen, 1973, 1985, 2009). The notion of social interaction to construct a mutually supportive and trusting environment has been attested for health care (Haslam and Reicher, 2006). Schoorman et al. (2007) fail to consider this socio-collaborative aspect. This is particularly important when considering that the management of a chronic health issue involves both H2H and H2T interdependence, stretching the model to consider what, if any differences there may be between trust (a H2H construct) and reliance (a H2T issue) (Weckert, 2011).

The other area Schoorman et al (2007) highlight as missing from the original model from Mayer et al. (1995b) is affect, or emotional response. A three-component model of trust based on the interplay of cognition, affect and behaviour is well known in different areas (LaPiere, 1934, Maio and Haddock, 2009, Haddock et al., 2008, Mercer and Clayton, 2012, Lewis and Weigert, 2012). The influence of affect and expectation on cognition has been attested since very early psychological research (Bruner and Goodman, 1948, Bruner and Postman, 1949, Bruner, 1991). Once again in a healthcare environment this is likely to be relevant: sufferers of chronic, debilitating conditions may be subject to different motivators than simply propensity to trust and the (regular evaluation of) trustworthiness factors (e.g. ability, benevolence and integrity) as Mayer and his colleagues suggest. Further, the clinicians and

medical practitioners may be willing to overlook apparent unreliability or even gross inadequacies because of their experience as clinicians dealing with inherently variable 'performance' (Dutton and Shepherd, 2006). Furthermore, the notions of cognitive miserliness (Dickerson, 2012, p242ff, Fiske and Taylor, 2013) and transference (McEvily et al., 2003) may ultimately affect trusting behaviours, since patient expectations of benevolence from the institution of healthcare (the National Health Service) may create assumptions about trustworthiness of associated technology as well as introduce the weight of experience from past treatment and care plans.

The model proposed by Mayer et al. (1995a) has certainly been influential in terms of work on person-to-person trust. As they later concede (Schoorman et al., 2007), the original model though fails to consider affect or indeed that trust is socially constructed. For different domains, not least healthcare management, this is a particular failing. Beyond the use of technology for purely diagnostic or investigative purposes (scanners and other sensors, for instance), if technology is used as an integral part of a care regime involving both humans (patients as well as their medical team) and technology (for monitoring, aggregating information, etc.) then these aspects will become essential. The wider issue relating to usability is not simply about trust transfer, but also about the relationship between the trust in the medical team and how it relates to trust in technology.

With this in mind, others have proposed different variants explicitly based on Mayer et al. (1995) as well as (semi-)independently motivated. Although lacking the essential temporal and constant regulatory feedback loop of Mayer et al. (1995a), McKnight & Chervany attempt to introduce multiple sources of trust and dimensions into their approach, as reproduced in Figure 2 (McKnight and Chervany, 2001a).

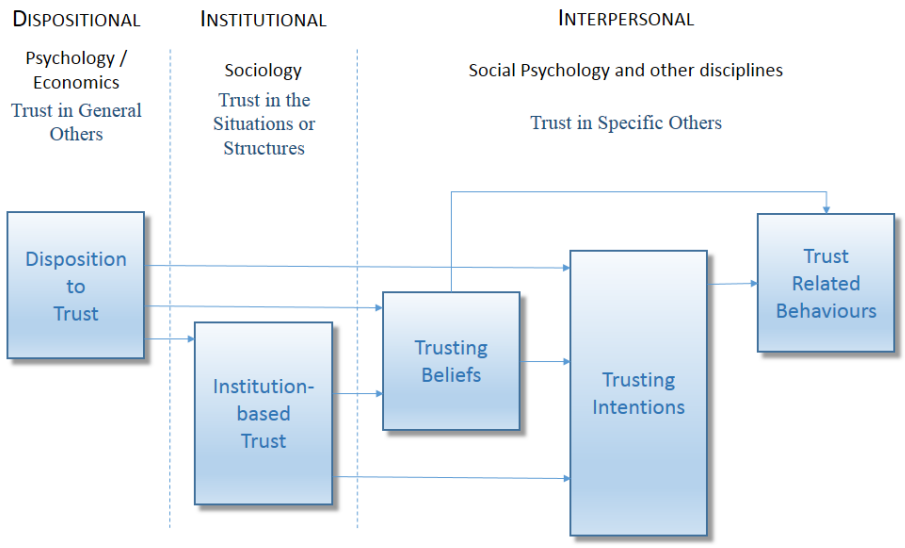


Figure 2: The multi-faceted nature of trust after McKnight & Chervany (2001)

They walk through a meta-analytic construction of a matrix of conceptual types (Table 1, p32) in preparation for the conceptual model they propose. To some degree, they confine aspects of the Mayer et al. (1995a) model to the domain of psychology, perhaps even including risk estimation given their inclusion of economics within the category *dispositional trust*, on the one hand, and the behavioural outcomes in 'trust related behaviours' on the other. However, and unlike Mayer et al. who simply assume person-to-person trust to be relevant for organisations as well, they consider institutional factors separately (op.cit., p28 & 34, et passim): that is, how do individuals react within a specific domain of interaction, in our case trusting technology within healthcare condition management. *Trusting beliefs* involves the concept of *benevolence* introduced by Mayer et al. along with *ability* (p36); *trusting intentions* relates to the willingness to accept vulnerability (p34); whilst *trust related behaviours* is the behavioural consequence of that willingness (*loc.cit.*). The latter three, but also the *institution-based* trust introduces the social interactional dimension explicitly which Mayer et al have missed. Finally, McKnight and Chervany (2001) offer *distrust* as a functional equivalent of *trust*: individuals will make a reasoned (cognitive) or emotional (affective) decision to expose themselves to the risk of vulnerability or otherwise chose to withdraw and withhold it (op.cit., Section 6, p41ff). Although intending to create both an inductive as well as predictive categorisation of concepts from the literature (op.cit., p48f), their model goes some way to attempt to redress the balance and bring back interactional considerations in predictions associated with trust, allowing thereby for a slightly more complex and layered approach, not least within more of a social constructionist paradigm.

Trust in Technology

McKnight and his colleagues (2011) continued to work on trust, specifically on trust in technology investigating the post-adoption construct rather than initial trust or its formation. McKnight et al. (2011b) conducted a meta-analysis covering general trusting beliefs in technology, trusting beliefs in a class of technologies, trust in specific technologies, as well as trust in people (*op.cit.*, Table II). As a result, they generated an updated version of their previous thinking on the multi-faceted nature of trust (see Figure 2) to create the model shown below (Figure 3). Briefly, the model encapsulates an individual's willingness to trust (*propensity to trust*) along with perceptions of the context or institution (*institution-based trust*), and as such starts at least with reference to the earlier McKnight and Chervany (2001b) approach (see Figure 2 above). The aim now though is to consider how these may influence a willingness to explore a technology post-adoption.

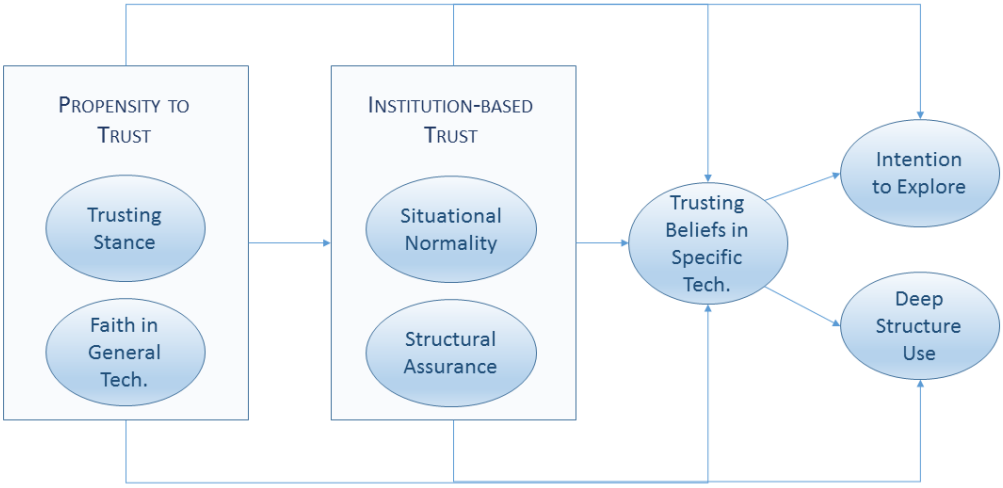


Figure 3: Constructs of trust in technology proposed by McKnight et al (2011)

McKnight et al (2011) attempted to validate the model in a questionnaire-based study of some 359 business students at an American university and their attitudes towards Microsoft Excel (*op.cit.*, p11ff). These authors validated their proposed model in terms of a willingness to explore other features, once a technology had been adopted. They introduced a specifically experiential dimension (how the students/users interact with the technology) in its influence on technology adoption (cf. Lee and See, 2004 and their discussion on affect), as well as explicitly linking their model to the technology acceptance model (TAM see below), which itself has been widely used in human factors and related areas of technology design and implementation (King and He, 2006).

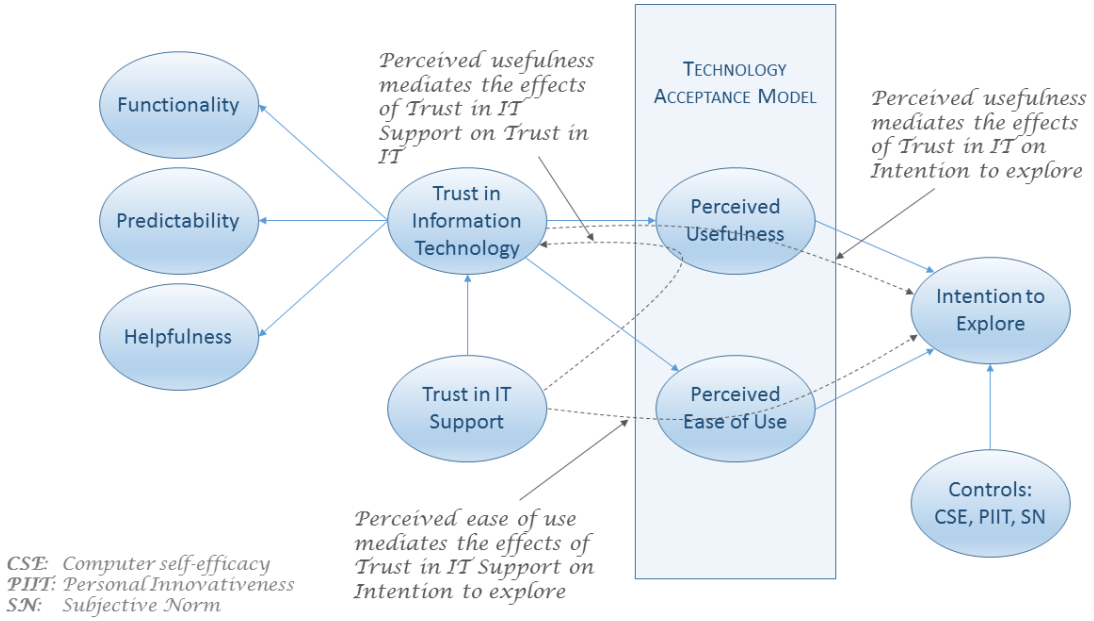


Figure 4: "The Role of Trust in Postadoption IT Exploration" (Thatcher et al, 2011)

In Thatcher et al. (2011), research McKnight also examined the role of trust in postadoption behaviours. This time, and notwithstanding the continuing distinction between trust in technology as opposed to trust in people, they introduced a consideration of the effect of trust towards human agents. As outlined in Figure 4, they were interested not only in the role of trust in technology, associated as it is with familiar constructs such as functionality, predictability and helpfulness, but also in those supporting and thereby representing technology (here "IT Support", following the call in McKnight et al. (2011b, p15) to examine the influence of the "dynamic interplay between users' trust in human agents that built a system, human agents that introduce a system, those that support a system, and the technology itself"). They sought to test the model with two studies, the first involving 172 business students, the second with 167 professionals. Results were consistent for the two user groups[4]. They found that perceived usefulness mediated the influence of trust in IT technology on an intention to explore (use the technology further) and similarly perceived ease of use mediated the effect of trust in IT support on an intention to explore. In addition, perceived usefulness was also found to mediate the influence of possible trust in IT support on trust in IT technology. This latter finding adds to the McEvily et al. (2003) claims about trust transfer: there is for these users at least a mediating effect from features of the technology itself.

[4] See also KING, W. R. & HE, J. 2006. A meta-analysis of the technology acceptance model. *Information & Management,* 43**,** 740-755. who similarly found no difference between students and professionals in their trusting behaviours.

The work by McKnight and his colleagues are important for a number of reasons. First, they mark an attempt to look specifically at trust in technology as an independent construct, which may or may not be mediated by trust in people but which has to be viewed differently. Second, they look at trust in a postadoption stage: this is not about initial vulnerability to risk, but a more cognitively and experientially based decision to continue and extend technology use. Third, they provide an obvious link to the technology acceptance model (TAM) which has long been cited as an approach to understanding why people are prepared to work with technology.

The Technology Acceptance Model (TAM)

The addition of the box "Technology Acceptance Model" in Figure 4 highlights the two major components common to the TAM. Over its development, researchers have sought to introduce influencing external factors, such as experience and whether or not the user is engaged voluntarily with the technology (Chuttur, 2009). The model itself seeks to extend the theory of reasoned action (TRA) (Sheppard et al., 1988) and of planned behaviour (TPB) (Ajzen, 1991), themselves insufficient to account for a willingness to adopt technology, to account for the decision to use and actual usage of technology (Bagozzi, 2007).

The external factors influencing perceived usefulness and perceived ease of use include concepts such as image, subjective norm, job (or task) relevance, output quality and so forth as well as computer self-efficacy, enjoyment, anxiety etc. (Chuttur, 2009, p14f), and where included at some level as 'controls' by Thatcher et al. (2011). Beyond this, the model is very simple: perceived usefulness effectively mediates the effect of ease of use on the intention to adopt a technology (King and He, 2006).

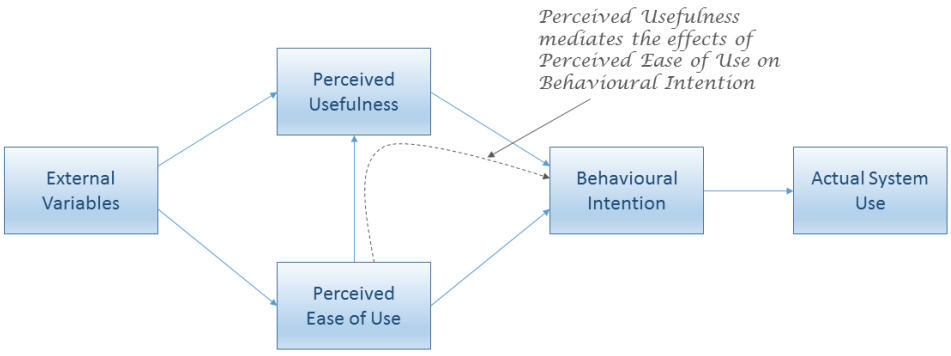


Figure 5: The 'final version' of the Technology Acceptance Model (Chuttur, 2009)

In addition to the external variables which may account for other sources of influence on perceived usefulness and perceived ease of use, Bagozzi (2007) sees the lack of inclusion of goal setting, group and social norms, emotional response, and self-regulation (*op.cit.*, p246ff) as major shortcomings in the model. To compensate, he suggests a decision making core (*op.cit.*, p250) to mediate the influence of usefulness and ease of use on the intention to adopt. Similarly recognising some shortcomings of the original TAM, and exploring the integrated model, UTAUT, proposed by Venkatesh et al. (2003), which explicitly includes considerations from TRA, TPB, and social cognition, Kijsanayotin et al. (2009) looked specifically at a healthcare context and the adoption of IT applications by medical staff. Once again, ease of use and usefulness were seen to be significant, but just as important were the beliefs of others and that users adopted the technology voluntarily, as well as experience with IT and the availability of IT support (*op.cit.*, p414).

The simplicity of the TAM may have been criticised and extensions proposed and validated, but nevertheless it remains a robust and generally applicable model (King and He, 2006). Although there is no explicit inclusion of trust, either dispositional or institutional, which led to UTAUT and the proposed Bagozzi (2007) decision making core, nevertheless it does highlight the relevance of usefulness and ease of use, both of which have been seen to influence online service acceptance (Egger, 2000, Fogg et al., 2003).

Trust in Online Services and Applications

Nass and Moon (2000) challenge a view that users misapply social metaphors to interaction with computers and online services, and conclude that there is a need for further research which does not specifically place human-computer interaction in the same light as human-to-human interaction. The TAM was one attempt to do this, and in extended form, looks robust and generalizable. Nevertheless, King and He (2006) identified online services as a separate and special case: trusting behaviours for one IT service would not automatically transfer to the Internet (*op.cit.*, Section 3.5.2, p748ff). Fogg (2003) proposed the prominence-interpretation theory to explain how users assess the credibility of a web service, finding validation in a large-scale study using two live sites (Fogg et al., 2003). But this is really about content and aesthetics, and how they influence antecedents of trust.

An alternative is proposed in the model of trust in electronic commerce (MoTEC) developed by Egger (2000) in an attempt to capture those features of online interaction which explicitly affect trust. Taken directly from Egger's original (*op.cit.*, p2), the figure should be viewed from the bottom upwards. Before any interaction takes place, the potential customer will make decisions about using the shopping sight based on perceived trustworthiness: what is known about the vendor (*reputation*) and what do others think, or was my previous experience (*transference*). Both affect the decision to engage, with trust as essential for any interaction to take place (McEvily et al., 2003). The next layer involves perceived ease of use and the customer's experience with terminology and layout (*familiarity*), as well as an affective response to the look-and-feel (*attitude*); this is where Fogg's purely impressionistic model may sit (Fogg, 2003). Finally, the informational content refers to financial and

commercial information about themselves that the vendor provides (*risk*), openness in respect of business policy and privacy (*transparency*) and the facilitating effect the site has on the vendor-customer interaction (*co-operation*).

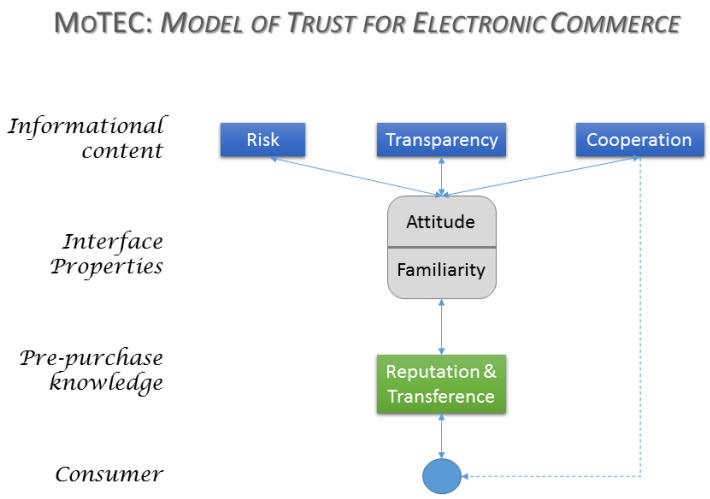


Figure 6: Trust in eCommerce, after Egger (2000)

The MoTEC combines issues of experience with ease-of-use and aesthetic appeal, though not as explicitly as the TAM/UTAUT models above, nor does it explicitly recognise anything like usefulness, presumably because it is simply assumed that the (potential) customer wants something otherwise they wouldn't access the website in the first place. Where it goes further than TAM, though, is in the introduction of provider-consumer interaction (a social cognitive element) and, although this is essentially technology mediated communication, the potential to incorporate both trusting attitudes towards the technology as well as to associated human agents which McKnight et al. (2011a) and Thatcher et al. (2011) include in their model.

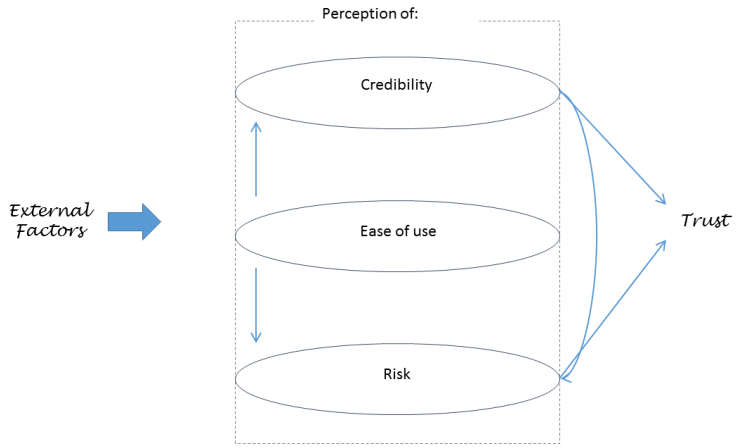


Figure 7: Trust in Online Applications (Corritore et al, 2003)

Corritore et al. (2003) offer a much simpler model, combining much of the *reputation* and *transference* in Egger's (2000) model into *external factors* influencing the precepts leading to trust. The latter include once more ease of use, which mediates credibility (which they define in terms of honesty, expertise, reputation and predictability (*op.cit.*, p750)) and also the perception of risk, which relates to a feeling of being "at the mercy of the website" and without control (*op.cit.*, p752).

The main factor which these approaches introduce into models of trust is an aesthetic dimension, whilst retaining factors such as reputation and expectations around what the service will do from the models cited previously, along with the essential. Corritore et al. (2003) go further in their study with an affective as well as cognitive emphasis within the specific concept of online trust. As depicted in Figure 8[5], they are concerned with the multiple dimensions of scope ("generality" (Section 2.5.1, p742f)), as well as the creation and maintenance of trust ("kind", "degree" and "stages" (Sections 2.5.3, 2.5.2 and 2.5.4, p 743ff, respectively); however, they do not explicitly seek validation of these factors. McKnight et al. (2011a) examine elements of person-to-person interactions, as do Lee and See (2004), who go further in looking at the affective dimensions of trust (*op.cit.*, p51; see also p62) as well as the dynamic stages for trust development and maintenance (*op.cit.*, p66f).

[5] NB: unlike the other figures in this section, this figure is our interpretation of the discussion in Corritore et al, 2003, rather than a copy of a figure they produce.

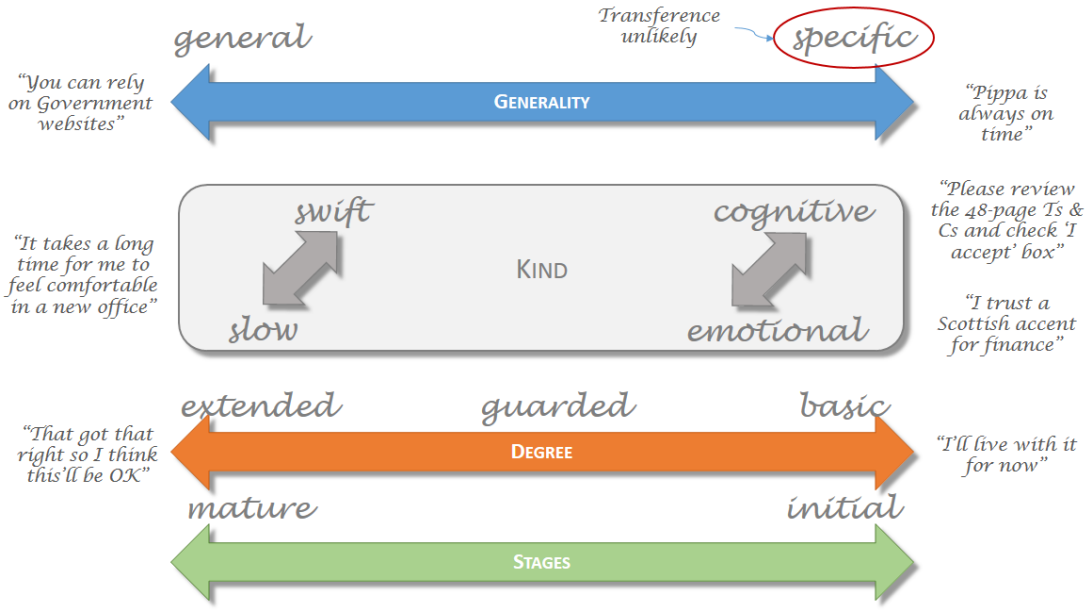


Figure 8: Dimensions of on-line trust after Corritore, Kracher & Wiedenbeck, 2003

In view of the above mentioned discussions therefore, and in order to explore trust in technology including online interaction, we consider that there is a need for a model which adopts and validates all of these components: ease of use, usefulness, aesthetic appeal, interaction, and some acknowledgement of expectation, experience and reputation.

The Formation of Trust in Technology

The introduction of social constructivist as well as cognitive-affective aspects is a welcome and long overdue development. One final model, however, needs to be considered in this context which has recently been developed by Söllner et al. (2012). Figure 9 presents a trust model which shares much with the original Mayer et al. (1995) approach, specific to the area of IT technology, and which includes parameters within the overall construct which facilitate the introduction of affect as well as cognition. In the previous section Trust models, we have already drawn parallels back to Mayer et al. (1995a); and these non-isomorphic mappings are shown in the figure below. Although Söllner et al.'s (2012) model fails to include the contextual features in McKnight et al. (2011b) nor the explicit feedback mechanisms of the original Mayer et al. (1995a) it was developed explicitly with reference to technology acceptance (Lee and See, 2004) and includes both first and second order constructs.

Focusing on the formation of initial trust, Söllner et al. (2012) explicitly set out to develop and validate a model of trust in technology as trustee, rather than trust in people as mediated by technology (*op.cit.*, p2). Taking up the call from Nass and Moon (2000) to focus on human-to-machine trust differently to human-to-human constructs, and building on the work of McKnight et al. (2011a) and Thatcher et al. (2011), they develop a model of trust formation including first and second order constructs. At the first-order level, the concepts of

performance, process, and *purpose* are based on earlier work by Lee and Moray (1992), to which they add the second-order constructs proposed by Lee and See (2004). By introducing intuitively meaningful characteristics (the second-order constructs) attached to each of the main trustworthiness parameters (the first-order constructs), Söllner et al. (2012) offer the potential to engage directly with different stakeholders, as stated above, but with the explicit intention of investigating their understanding (cognition) and their response to (both in terms of affect, as well as behaviour) IT technologies.

Figure 9 summarises the first and second order constructs in their model. *Performance* in Söllner et al.'s (2012) terms relates directly to the success or otherwise of the IT artefact in helping a service user to achieve their goal (Söllner et al., 2012, p4); but more importantly this relates directly to factors such as how accurate the information / content that it provides might be, how reliable the application or service might be, and whether or not the service or application contains all the necessary functions required in achieving the user's intentions and goals (Söllner et al., 2012, p5f). What this model provides are tangible gradations on the overall perception of whether or not the artefact does what it's supposed to for the service user to get what they want from it. And so it is with *process*, or the extent to which individual components within the overall service or application do what is expected of them (op.cit., p4), and *purpose*, or the intentions of the service provider and / or service developer in providing the service at all (loc.cit.).

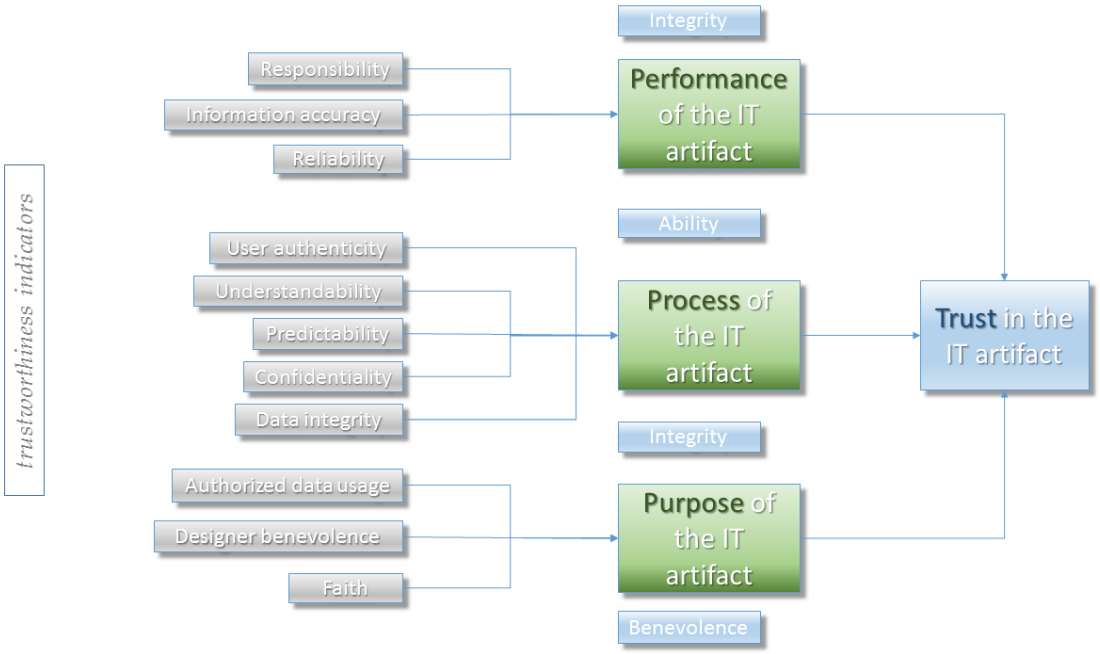


Figure 9: The model of trust specifically for IT artifacts from Söllner, Hoffmann, Hoffmann, Wacker & Leimeister, 2012

Söllner et al. (2012) subsequently and through direct engagement with users, attempt to validate the impact of these factors on trust. In so doing, they validate their appropriateness, but specifically identity that anything to do with the integrity and security of data (especially

user data) are of special relevance (op.cit., p14). Overall, this provides some insight into what needs to be taken into account by service developers and providers (loc.cit.)

As well as validating their impact in this way, the features and sub-features become accessible when considering a specific service or services. Through the sub-features subsumed within the three high-level trustworthiness features in this way, what Söllner and his colleagues have done is to provide a testable set of factors which can be put directly to the various stakeholders to establish whether they are relevant and comprehensive in accounting for the development and maintenance of trust in IT systems. For a service on healthcare and care management, for example, this helps engage service users in the discussion of what is and isn't important to them if they are to build trust in supportive technology. What is more apparent however, is that these same features provide a common understanding and exploratory background against which to consider the trust relations which the service user has or needs to develop with their medical team, thereby throwing into relief the relationship between the two: the HCI, or H2T, dimension as well as the H2H.

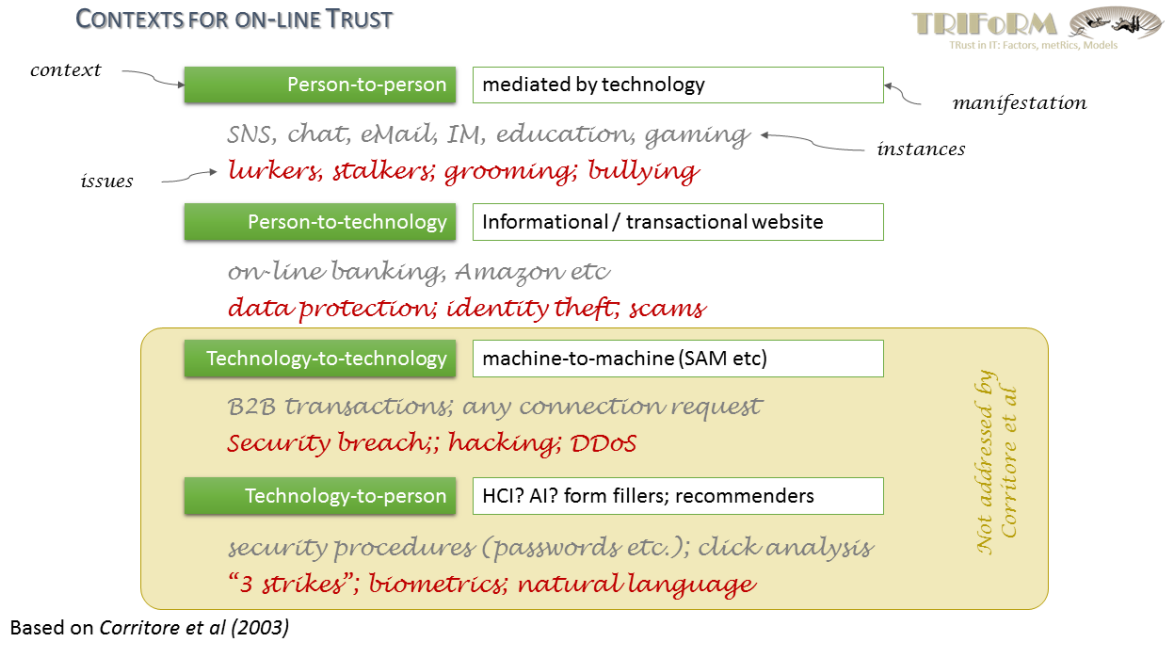


Figure 10: The various contexts within which trust relations are relevant within a technology context (based on Corritore, Kracher and Wiedenbeck, 2003)

Concluding Remarks

Pertinent to this project we draw together elements of different models of trust. Specifically, we consider the Söllner et al. (2012) model of trust which reflects consideration of system performance, process and purpose, borrowed from systems theory within HCI domains (e.g., Lee and Moray, 1992, Lee and See, 2004, i.a.), and combine this with interpersonal factors which McKnight et al. (2011b) made

contextual to technology. As these authors argue: "*users' beliefs may differ based on their experience or the context for its use….. thus users express expectations about different attributes*". (12.5) For example based on Mayer et al. (1995a) interpersonal factors of competence, benevolence and integrity, McKnight et al. (2011b) developed bespoke constructs reflecting human expectations of functionality, helpfulness and reliability respectively in initial trust in adoption of novel technology. Söllner et al. (2012) provide a model which attempts to draw these strands together.

By adopting this hybrid approach we can also tap into the wider socio-technological system of trust, incorporating different stakeholders/agents that are involved in the wider network such as designers, clinicians, service providers etc. Thus utilising this framework enables us to gain a more detailed insight into the perception of trust across a wider context, rather than solely relying on either the user's interpersonal perceptions of trust based on H2H beliefs, or their perceptions of trust in the IT object as a trustee.

Appendix II: Thematic Analysis of Interview Responses

To investigate the level of trust that a healthcare application might involve, five potential service users[6] and a service provider were recruited to respond to a brief online survey and take part in individual semi-structured interviews via the telephone[7]. The initial plan was to interview users of an existing service under trial. However, this may encourage more positive responses, in that participants may be anxious to encourage ongoing research into services which may directly improve their own situation (Henchy and Glass, 1968, Minor, 1970, Eysenck, 2009, p. 544). For the purposes of this pilot study, therefore, we approached chronic pain sufferers who had shown interest in finding out more ways to manage their condition, but who were not currently involved with such a trial. No explicit demographic information was collected on service-user participants; the service provider is involved in the treatment of pain, as well as the design and development of assistive technologies.

Participation comprised two stages: a brief online survey to provide some indication of the participants' propensity to trust in technology; and a semi-structured interview around specific trusting behaviours associated with a proposed healthcare application. The online survey included six simple assertions to be responded to using a four-point Likert scale: *completely agree*, *agree*, *disagree* and *completely disagree*. Three of the assertions were based on a study on the relationship between trust and individual well-being, selecting one from each of four factors and changing person-directed to technology-directed statements (Ashleigh et al., 2012), along with two general human-to-technology statements associated with common services and applications (banking, social-media, etc.) from OPTET (The Optet Project, 2014). The online survey was preceded by a consent form, covering both the survey and a subsequent interview. One participant did not complete the online survey; the results for the others are shown below (Table 1).

The end of this appendix provides the guide that was given to the interviewer in each case. Interviews were conducted over the telephone, recorded and professionally transcribed, pseudonymising as required to protect the anonymity of the participants. Two of the investigators (the "coders") then reviewed the transcripts to identify trust and technology acceptance behaviours or opinions (or "themes"). A third investigator then analysed the themes generated in this way, by way of an approximation to a hybrid thematic analysis (Braun and Clarke, 2006 , Howitt, 2013, Chapter 7, Coolican, 2013, p. 257ff) including:

- A *theory-driven approach*: the constructs in the Söllner (2012) model were used to identify themes within the interviews; as well as
- A *data-drive analysis* allowing other themes to be defined as raised by the participants (Braun and Clarke, 2006, p88ff).

[6] There were originally 6; but after the interview, one participant decided to withdraw completely.

[7] This study was approved by the Faculty Ethics Committee under reference **ERGO/**FPSE**/**14892.

There was no attempt at further quantitative analysis in terms of the incidence or prevalence of themes across the six interviews. There has been no attempt at this time to relate survey responses to views expressed by participants.

QUESTION	PARTICIPANT TYPE[8]					
	SU1	SU2	SU3	SU4	SU5	SP
Technology, services, and systems do what they say they will do.	No survey	A	A	A	A	D
Social networks are a great place to meet new people and keep in touch with friends and family.		A	A	A	CA	A
Technology, services, and systems can be relied upon to disclose risks of using them, and disclose errors when they occur.		D	D	D	D	D
Online banking is safe.		D	A	A	A	A
Technology, services and systems are only focused on their own goals, not mine.		CA	A	D	D	D
I tend to wait for others to try services before I do.		A	D	D	CD	A

Table 1: Participant judgements on their propensity to trust technology

CA	Completely agree
A	Agree
D	Disagree
CD	Completely disagree

An approximate indication of the consistency of the coders was calculated on the basis of specific sections which they both identified as relevant, and then in terms of the themes which they agreed on, including the data-driven ones. These consistency measures are shown below (Table 2): only those cases where the same extract is identified and labelled with the same or similar code are deemed in this consistency check to amount to a converged view. Although based on extremely tough criteria, therefore, and no more than a crude indication at this time of the overlap between the two coders, these measures suggest agreement of around half the cases of what was actually said and interpretation of themes. A more detailed analysis would doubtless reveal similar themes identified by both coders but associated with different extracts in the interview.

[8] SU=Service User (SU1 = AB; SU2 = IF; SU3=JB; SU4=PP; SU5=SB); SP=Service Provider

QUESTION	PARTICIPANT TYPE						TOTAL
	SU1	SU2	SU3	SU4	SU5	SP	
Same section highlighted	8/27	7/13	15/24	15/33	23/35	9/25	77/157 (**49%**)
Same conclusions / themes	7/15	2/8	8/16	12/19	14/23	4/19	47/100 (**47%**)

Table 2: Consistency of coder responses to the interviews

Coverage of the Söllner et al Model

Over the course of the interviews, and without going into specific detail, all first-order and second-order constructs from the Söllner et al. (2012) model are attested in the views expressed by the participants as shown in Figure 11 below.

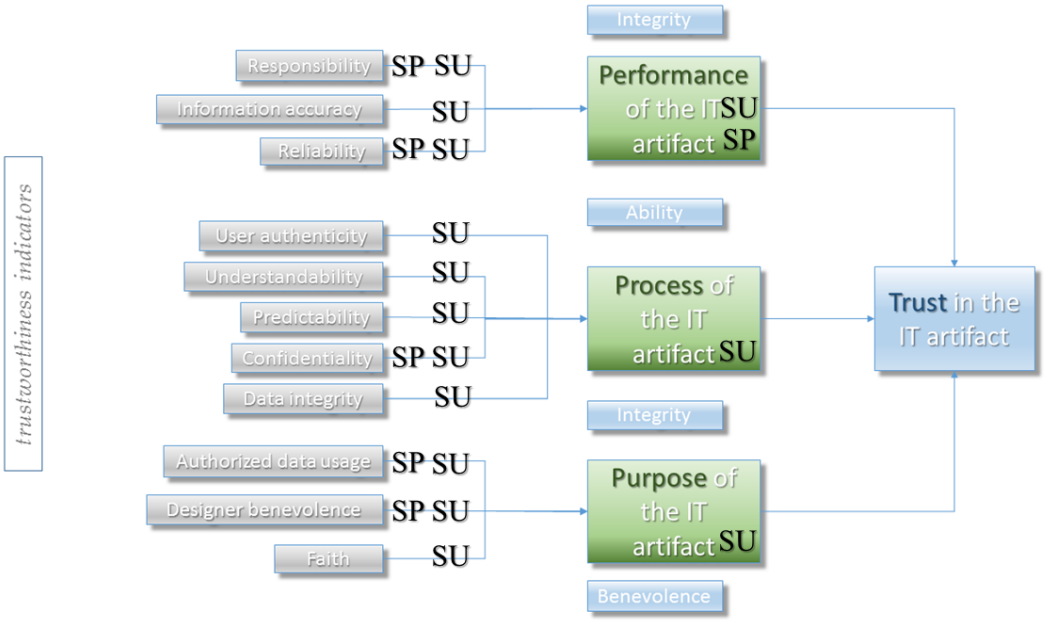


Figure 11: Constructs in the Söllner et al model identified in the interviews with the Service Provider (SP) and/or the Service Users (SU)

Especially in respect of the service users in our study – the rheumatoid arthritis sufferers – all constructs are covered: as far as trust formation is concerned, remembering that these are participants who have yet to have experience any such technology, the model seems well grounded in the views of our group of healthcare service users. Although Söllner et al. (2012) validated their model with some 248 undergraduates (*op.cit.*, p8) and King and He (2006)

suggest that students may be representative of professionals but not the general public (*op.cit.,* p747f), here we find support for the constructs of the model from general users themselves. Although this is only a pilot study, nonetheless these findings are encouraging.

Thematic Map

An inductive analysis of participant views as highlighted and interpreted by the coders revealed four major themes:

1. *Technology acceptance:* how willing the participants were to trust and adopt the technology as described;
2. *Human-computer interactions:* what effect different aspects of the technology has on willingness to trust and accept the technology as described;
3. *Trust Transfer:* how trust in the overall healthcare management process (and individuals supporting that process) might also affect trust and acceptance of the technology; and
4. *Demographics:* how the culture and specific characteristics of potential service users might affect trust and acceptance of the technology as described.

The associated thematic maps are shown in Figure 12 and Figure 13. The two figures show the major themes above along with sub-themes associated with them. For each theme or sub-theme, the figures in brackets show how many service users mentioned the topic, followed by whether the service provider did (=1) or did not (=0) mention it. For example, with *Technology acceptance (3+1)*: 3 service users and the service provider mentioned this topic; with the sub-theme *Convenience (4+0)*, 4 of the service users talked about it, but the service provider did not. The arrows in the figure link themes with sub-themes and show some assumed relationships between themes or sub-themes associated with a different theme.

In the following sections, a brief description of the (sub)theme is provided along with the supporting evidence and any relevance to research previously covered in the literature review. In the interview extracts, "SUx" refers to the potential *service users* (x being 1 to 5), and "SP" is the *service provider*.

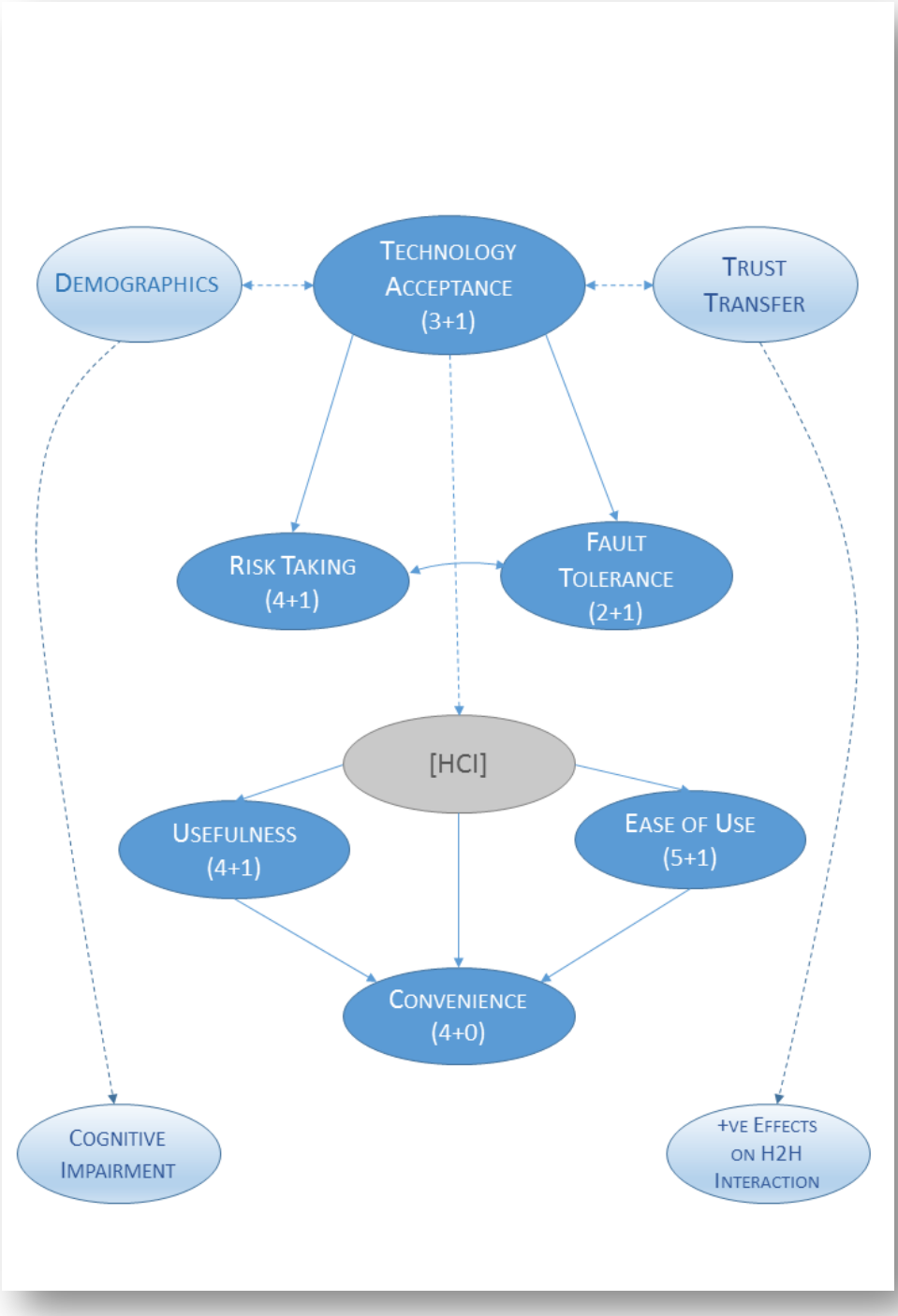


Figure 12: Thematic map of the Technology Acceptance construct in trust development

Technology acceptance

Technology acceptance emerged as a major topic: how did participants react to the thought of a healthcare management service, and what would encourage their initial trust and adoption of that technology?

Technology acceptance has been the subject of research across a number of areas, of course (King and He, 2006, Chuttur, 2009, Bagozzi, 2007). Although usually based on undergraduate perceptions of mobile and online applications, it has nevertheless also been reviewed in the context of medical teams' acceptance of an automated system (Kijsanayotin et al., 2009). These studies tend to focus on *usefulness* and *ease of use* (see below) as prime motivators for acceptance, at least for students and professionals (King and He, 2006), and regardless of application area. For healthcare professionals, though, IT experience, the availability of support, and a feeling that adoption is voluntary rather than imposed were also highlighted as mediating factors (Kijsanayotin et al., 2009). In this pilot study, our participants were undergoing medical care regimes for a chronic condition, so how would they react?

For the users, technology acceptance and trusting the technology in general is partly to do with brand and reputation:

> SU3 I think that Apple, up till now, has been slightly lower risk because they've been in a minority

Nevertheless, there was also a sense that people do enjoy what technology can provide them, and so are prepared to trust and accept it.

> SU4 I actually quite enjoy what you can get from it, the benefits you can get from it. Yeah, I do have to use it for my work but I actually enjoy using it and I love what it can do.

Beyond that, there is also a sense that technology, if accepted, can provide access to services and a way of doing things that would otherwise not be available. Motivation therefore is an incentive to trust the technology.

> SU5 Yes. We've just moved into a small town but we were in a village that didn't have a shop so we all use it quite a lot. And [Place Name] is not a particularly big place so rather than get in a car we tend to do. We don't often do supermarket shopping online but I have done. And the other thing online is that […] I'm hoping I can do it with our new GP surgery, but you can make routine appointments online and ask for prescriptions online […] So I'm used to using that so that's been really helpful.

Technology acceptance is not without its problems though for service providers: there is some resistance to using technology which may be related to familiarity:

> SP Our problem is to get over that cultural barrier of getting people to use it.

And it's not only the potential patients as service users who may be resistant; the medical teams themselves may find technology intrusive.

> SP I think it's probably due to the fact that out there in the field, for sure, clinicians have a routine, they have their own clinic. Most of our guys […] have their routines, they know what they're doing, they like to do it the way that they do it. It's the perennial issue of managing change and encouraging change. I think that's where the problem is.

So if motivated and appropriately positioned, technology supporting a healthcare regime is likely to be accepted, although there may be some initial resistance to accepting change. It's clear, however, that technology acceptance here really is about usefulness: what it does for the potential service-user.

We also found two related sub-themes: *risk taking* and *fault tolerance*.

Risk taking

If trust is about accepting vulnerability (Mayer et al., 1995a, Rousseau et al., 1998), then it was unsurprising to find some discussion of risk associated with *Technology acceptance*. For some of the users, there is simply no choice: they have to accept risk, because there is no alternative than using the technology. It's not so much trust as necessity.

> SU3 [I] am a bit more nervous than I used to be but the alternative, which is not to use any of these things, is not an option for me

At the same time, though, there is a cognitive decision to accept risk, on the basis that the information is only relevant within this specific context; and that this context is completely trustworthy anyway.

> SU4 But quite honestly if medical people can't be trusted who can. That's different from if it could be hacked and somebody could… but then I thought, well, what are the downsides of somebody knows the drugs I'm on? You know, they can't deal with it illegally. I couldn't actually see a downside.

What is more, there is also an acceptance that it is not always the technology itself which is at fault:

> SU4 Well, yeah, we've all heard about financial details getting left on trains in briefcases and stuff. I mean, that was user error rather than technology failing. I'd like… I don't know. There's always a threat or a possibility that things could go awry and things could get misused or end up in the wrong hands.

A sentiment shared by all parties, including the service providers themselves:

> SP Obviously the weak link is always the human being and people taking photographs of screens and stuff like that or printing stuff out.

But at the end of the day, it appears, until experience has developed, no one really knows; it's perfectly reasonable to expect to spend some time getting to know what the technology does and how to use it appropriately.

> SP And of course until you take the leap of having a go, you know, taking a little time like with any new software thing.

As far as risk taking is concerned, therefore, there is a pragmatic approach adopted by potential users: on the one hand, the service is so important that there may be no other viable alternative to accepting and living with the risk, but at the same time, there is a responsibility on the side of the users too. Perhaps this, then, is a case of "guarded trust" as Corritore et al. (2003) assert.

Fault tolerance

Of course, a willingness to entertain risk goes hand in hand with accepting that errors do occur. For Dutton and Shepherd (2006), continued use and the development of some degree of expertise will tend to increase fault tolerance. By contrast, Lee and Moray (1992) recognise that errors or system faults can lead to a loss of trust, but this is only temporary; and depending on the confidence of an operator will lead to different recovery strategies. Schoorman et al. (2007) also recognised that error recovery is an important influencing factor for the long-term maintenance of trust.

There is a fairly practical approach to errors from users: problems *may* occur, but until they do, it's pointless worrying:

> SU4 We might come unstuck somewhere along the line but thus far I trust it […] and I don't see any reason for that changing, thus far it's, after a few initial teething problems, it works fine.

At the same time, there seems little reason not to trust the technology; in general, it's perfectly functional:

> SU4 […] interesting word 'trust'. Yeah, I trust that it should do what it does. I know things crash and files not go missing but you can delete them. But generally speaking I trust technology to do what it should.

There is also a realisation that fault tolerance works both ways: if users accept that technology can throw up errors, then services and applications should be designed to tolerate users. There should be mechanisms to recover from errors.

> SU5 Because some websites, when you're putting stuff in, you get to a certain place and you want to change it you have to completely come out of it and start right again at the beginning in order to change anything. […] I can imagine if you were having a bad day it would be quite easy to press the wrong one without thinking and think I meant really bad not really good

For the provider, there has to be a realistic expectation that things will not always go right from the start:

> SP I'm just very sanguine about the limitations of technology, especially new technology, in the sense that, you know, it is very difficult to get these things off the ground working perfectly.

and this is true for any technology supplier:

> SP Even people like Apple fall over on a regular basis and they're huge

but there needs to be collaborative engagement to handle change, including faults, during the early adoption period.

> SP It's the perennial issue of managing change and encouraging change.

There is a general acceptance, therefore, if not expectation that problems will occur. However, this will not necessarily undermine trust or a willingness to adopt a given

technology. Technology provider and user need to be realistic and manage problems if they arise.

HCI

Although we cannot necessarily assume H2H and H2T to be the same (McKnight et al., 2011b, Thatcher et al., 2011, Söllner et al., 2012), there may well be similar, mediating constructs (Corritore et al., 2003). Independently of such considerations, though, work on technology acceptance, and especially consideration of user reactions to online content (Fogg, 2003, Fogg et al., 2003), responses as active or passive users of technology (Xu et al., 2014), the role that trust plays in encouraging the adoption (Egger, 2000, Söllner et al., 2012) and maintenance of technology use (McKnight et al., 2011b, Thatcher et al., 2011) provide sufficient background to consider features of the technology to be important in forming and sustaining trust as well as adoption. In technology acceptance terms, this generally comes down to *usefulness* and *ease of use* (Chuttur, 2009).

Usefulness

Most participants were indeed keen on anything which would help in the management of their condition. There is an appreciation, for instance, for technology and services which provide practical help in managing a condition:

> SU3 […] and it was very useful actually until… I never believed it would become second nature to me to take all these pills […] But in fact I have learned it off pat. But until I did I had this app called [Pill Scheduler] and there would be alarms and everything and it would tell me what to take.

or to help make appropriate decisions about what to do:

> SU5 It's something they can use on a computer and on a phone. They put in all the data about it and it tells them what dressings they should be using.

even if only one particular feature seemed worth having, in this case an aid to keeping track of the condition:

> SU4 So I think that could be really useful, the self-reporting stuff.

or doing something which is or is becoming difficult to manage otherwise: remembering all the information you might want to tell your clinician, or even to get in touch with the surgery:

> SU5 That sounds something that would be quite useful. It

> would be quite useful to have a way of explaining things instead of having to save it all up for a really frustrating 10 or 15 minutes when your clinic has been moved somewhere else and you've not managed to find it. By the time you get in it's often difficult to give them useful information. […] It saves having to remember to ring up at a time when the surgery is not busy and it means if you think, oh, I needed to book that appointment you can still do it at whatever time you think of it. I suppose it's doing the same thing but in a more flexible way.

At the same time though, there is a realisation that the rest of the ecosystem can derive benefit from the introduction of technology:

> SU5 And it takes a bit of pressure off the surgery as well because you don't have to ring them up, it just happens.

to the extent that even treatment might improve:

> SP It does that very well and it also provides very new data, in that sense, outside the traditional clinical encounter.

Although traditionally used in diagnostic situations, users do have an appreciation that technology can also be useful in other situations. This may be anything from specific details of what to do and how to do it, but also practical situations like providing an aide-memory or technology-based diary.

Ease of Use

However useful in managing a health condition, a technology needs to be easy to get on with, whether for purely practical reasons:

> SU3 But the iPad is a lot easier when I'm very stressed because it's flat and I don't actually have to bend the wrists in the same way.

and

> SU3 And it complements very well because I can use the iPad in bed.

The technology must respond quickly:

> SU1 It's quick information. It's getting information you want quickly.

And allow complicated tasks to be readily achieved:

SU3 And I could set off a complex series of alarms so it could tell me. I had to remember what that particular alarm meant.

Applications should be intuitive:

SU5 Some are better than others, aren't they, at narrowing it down to what you're actually looking for.

and easy to navigate, with straight-forward recovery:

SU5 […] it's really frustrating. Some menus aren't very… they're sort of a bit counterintuitive. And also an easy way to go back to where you were rather than having to go back. Back one step instead of having to go right the way back to the beginning and start again. You know, if you were doing it and something interrupted you and you thought I've just put something completely wrong in, a way of going back. Not necessarily to have to do it all again but just to say, oops, I made a mistake with that one. I could imagine it might be quite easy to go, oh, but actually I didn't mean that at all. I thought that was the other question. If you see what I mean.

Data must be requested as well as be presented in an appropriate and comprehensible way:

SU5 Is it not a problem at all? So something like that might be easier. It might not give you a number but you could presumably translate it to a number. It might be easier, especially on a phone application. Because it's not always that easy to read lots of words. And the completely dissatisfied /completely satisfied things, I sometimes find I've done them back to front.

And there is even a realisation that technology format needs to be carefully thought out:

SU4 So I'm wondering how, unless you go on to a smart watch or something and wear it on your wrist, I don't know, how accurate or how misleading that could be depending on the advanced-ness, as it were, of what it was recording or how it was recording rather.

Remembering in this case that we were talking about a phone-based application monitoring movement.

But there is also an appreciation that this is about give-and-take: the service provider had mentioned with errors and faults that users have their part to play; the users also appreciate that they cannot hide behind poor understanding:

> SU3 I think the application can only be as good as the users of it.

which the technologists might encourage by providing suitable feedback, the two-way communication you have in H2H contexts:

> SP But until you actually make that little bit of effort and then you get that feedback from a piece of software and you think, oh, this is really good.

Convenience

There seemed to be another strand to the discussion around technology usage and its adoption. To maintain trust and a willingness to engage with it, users also expressed their preference for convenience. There is an appreciation for technology which is not burdensome and fits in with every day like:

> SU1 Yeah, I really like the iPad. I find it easy to use and it doesn't take up any space. You can take it with you.

Technology is there to help, be flexible and offer up different ways of managing situations:

> SU4 It's something they can use on a computer and on a phone. They put in all the data about it and it tells them what dressings they should be using […] I suppose it's doing the same thing but in a more flexible way.

Convenience can also be an affective construct: the technology not only helps the individual, but it also means that they do not need to be concerned about inconvenience to others and not just themselves:

> SU4 […] bothering receptionists and having to explain who you are, what you want, blah, blah […] So it's just great. I don't hassle anyone, nobody has to hassle me and it works smoothly. So that's great.

And ultimately, the goal is to get to a place where the technology is regarded as essential or a commodity; at the very least something users would miss:

> SU1 I think I'd miss the convenience of it. It's just convenient. It's like lots of things, you don't have one and then when you have one it's quite useful and you think, oh, I'd quite miss it actually.

Part of user response to technology, the development of trust and adoption relates not only to usefulness and ease of use as the technology acceptance model might claim, it's also about how users perceive the benefits to them in terms of convenience and flexibility therefore.

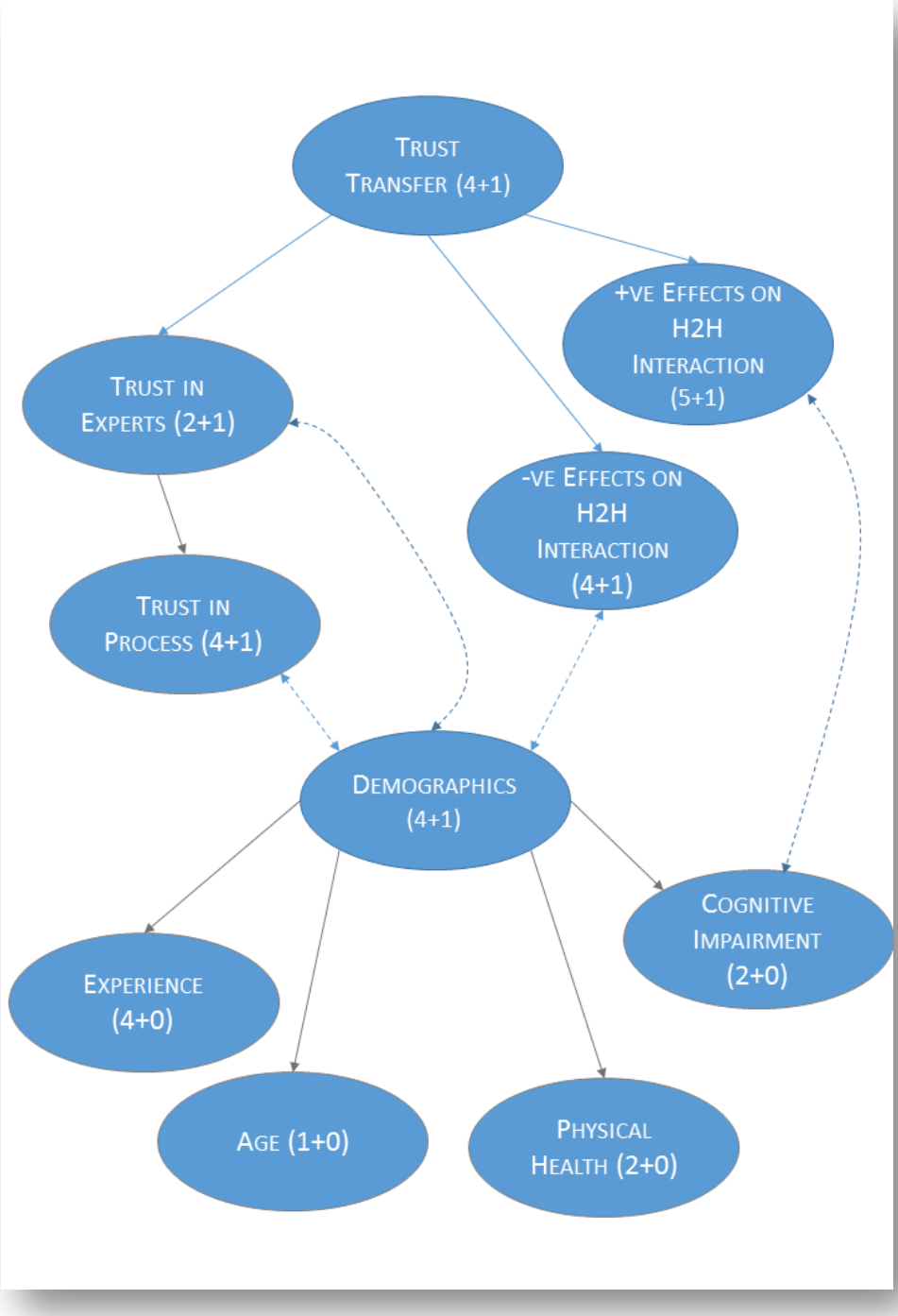


Figure 13: Thematic map of Trust transfer and Demographics in trust development

Trust Transfer

Trust transfer was introduced by McEvily et al. (2003) to explain interactions between human actors. If trust is the organising principle behind interactions, then trust in one agent or

component should logically transfer to others who enter that connection network. Whilst Nass and Moon (2000) argue against over anthropomorphising our relationship with technology, and McKnight et al. (2011b), Thatcher et al. (2011), Söllner et al. (2012), are keen to move away from assumptions that trust between humans can be equated directly to trust in technology, the context of this pilot study seems to represent a special case: trust in medical technology is different (Montague, 2010). Nonetheless, our participants did expect to be able to trust the types of technology we described in the specific context of their care regime.

On the one hand, there is the assumption that it is the medical team, not necessarily the patient who knows best:

SU2 I think the medical people would be the best ones to answer that rather than me.

Although there is also recognition that H2H interactions are especially important, and should not be replaced by technology:

SU4 But I like the fact that I can go are these achy elbows, are they part of the condition? Should I be doing more exercise or less? Is it tendonitis? Is it synovitis? So at those meetings it's not a case of me just reporting and him listening to my report let alone what electronic reports might be coming, but it's the communication. It's the two-way communication. It's the interaction. It's not just him being fed stuff and him going I don't need to see you because I've got everything here, you can sit there being quiet or something.

Not least because it is the medical team as a whole who set the tone; if the human actors are competent and caring, then this will increase tolerance for technical or system failures. Trust will not be immediately undermined:

SU5 The practice we've just had to leave because of moving is the most fantastic practice anywhere and I know that sometimes their system cocks up but it doesn't seem to cock up anymore whether I use it on the phone or on the computer or go in, in person

But there is also a recognition that trust in technology, and an assumption of the same degree of integrity as the medics may not always be appropriate:

SP Obviously the weak link is always the human being and people taking photographs of screens and stuff like

> that or printing stuff out.

A generalised view of trust transfer is complex, therefore: not all participants feel the same way. The individual sub-themes, however, provide a clearer picture.

Trust in experts

There seems to be an implicit acceptance that the medical team had the best interests of the service user at heart, covering benevolence and integrity from more traditional H2H trust models:

> SU1 Yes and the rheumatology nurse. So I have really good monitoring where I live. They have a really good rheumatology department so I see my consultant and I see my rheumatology nurse and between them I have really good care. I'm very fortunate.

Along with explicit trust in them:

> SU4 But quite honestly if medical people can't be trusted who can? […] I haven't really thought about it because I always assumed they were tickety-boo. And I'm sure they are. I certainly haven't had any reason to question or challenge that. I take it as read that everything is fine.

In return, the service providers (in this case as a clinician) take pride also in their attitude to the care process:

> SP [Our] three mission statements are to do with clinical excellence. To do with clinical excellence, to do with educational excellence and research excellence. So, you know, clinical stuff is up there as a third of what we do.

Technology in this context cannot afford to undermine the trust that either care givers or care receivers maintain. Trust is based on a belief in the competence and benevolence of the medical team as a whole.

Trust in process

The way that participants said they put trust in technology varied, but was context-aware. Whilst accepting that mistakes and breaches do occur with technology, there is an assumption that if users take sensible precautions, then things will be alright:

> SU1 I mean, I change my password a lot so they'd have to be pretty clever to get into my stuff. […] I think

it's just common sense really

Once that sort of behaviour is in place, then there is a willingness to trust that technology can make a beneficial contribution to overall care:

SU2 I think then, as I say, you'd have to have a certain amount of trust. And also you'd need some efficient communication, I reckon.

SU1 So I actually quite like that because I feel that they are checking on me. It's a good check-up system so that they can pick up on things.

There is an underlying assumption in all of this, though, that the broader healthcare context will provide some protection and integrity when it comes to sharing information:

SU4 I'd like to think anyone who works generally in the medical world, my GP's practice or whatever, I'd like to think that they're all of a professional level where, you know, if they did know something that that is confidential within the practice. You know, you don't go running round telling anyone else or a third party or whatever. I don't want it open to everyone maybe in the practice. I mean, I don't think that everyone needs to know. I don't know how that would be monitored but maybe the secretaries don't need to know or maybe they do if they're writing a letter to my clinician. But I'd like to think they're all professional.

However, this level of trust in the broader process and organisation extends only so far. In the even wider medical context of hospitals, for instance, it's not so clear that service users would feel so trusting:

SU5 I don't know how I'd feel about anyone in the hospital being able to access it. Because hospitals are much bigger places and you've got lots of people with access to digital notes on that system and that's possibly slightly different.

Against such a background, the service providers recognise the trust and importance of the H2H relationships. They see their role as providing technology to enhance those relationships and support all service users to get the best from the whole situation:

> SP And so where this care emerges from interaction between people, clinicians and patients being the central part of that care relationship, where technology adds to, enhances, supports, exemplifies that activity, I think it absolutely will be very, very important to how medicine and the clinical world develop. Where it's used to substitute it, I think that can be detrimental. So that's where I'd put the dividing line.

So there is a definite willingness to trust the overall healthcare process, which includes service users themselves taking some responsibility for their own actions. That being said, though, there is a degree of confidence that trust in the process will not be abused, confidential information and sensitive data will only be shared appropriately and to the benefit of the service user. It is therefore the responsibility of the service provider to maintain the status quo and enhance the overall experience with technology.

Positive effects on the existing human-to-human relationships

Taking the service provider's point further, there is an understanding of the special nature of interactions between the healthcare professionals and those they treat, even though technology may have a contribution to make:

> SU1 [The nurse] can see if you're not very well by your demeanour and the way you look of course. So I think it's a great balance of the two.

Indeed technology may improve the efficacy of this healthcare management relationship, filling gaps in information and a continuous record to be used in conjunction with the more intuitive social interactionist responses:

> SU2 Yeah, because I'm not the best historian really when I go. I'm not the best at describing pain. I'm not the best at giving a generalised account really. I find that difficult. So it might actually make things easier in that respect

and

> SU4 Because, exactly as you say, I go and see my clinician and it's like how are you feeling? And albeit I know the appointment is coming up and I try and think about how I'm feeling and noting things down and take a little list with me you always forget things or you can never quite pick on everything. Whereas if you do it

> day by day or weekly or whatever we're talking you'll be able to get a trend there rather than trying to summarise it without really taking an accurate record as you go along. So I think that could be really useful, the self-reporting stuff

Though all of that should be to the benefit of all involved, patient as well as carer, whilst maintaining the all-important therapeutic interaction:

> SU4 So I think it's imperative that the two-way communication is maintained. I think the technology, not the technology but the data should support the meeting not overtake or subsume it. […] I just thought it was a benefit for making everyone's life better or easier, both patient and the medical people.

Making monitoring data would have benefit, though, not only for the individual patient:

> SU5 That's a potential use for people because it would be a way of collecting data that you could log it as female aged such and such and then have a potted history if people were looking for it. They could say people who have used x, y and z drugs in the past and are now on this

Although not all stakeholders are equally convinced of the potential from technology:

> SP Sharing joint body movements that increase therapeutic alliance and confidence. […] And so in that sense I don't think it is a problem but other people perhaps, clinicians, are mixed on that. Some people feel that it would undermine that and some people wouldn't. So that's an interesting generic issue from a clinical point of view about how technology can be seen as both undermining that human interaction and other people see it as perhaps enhancing it.

Our participants therefore made it clear that they could see the benefit of using technology, which it appears they would be prepared to trust. In so doing, this would provide a useful addition to existing healthcare team efficiency and effectiveness.

Negative effects on the existing human-to-human relationships

But at the same time, there is also a note of caution. The introduction of healthcare technologies must include careful consideration of human interaction, because only then

could wholly effective intervention be guaranteed. This may simply include companionship and sympathy, of course:

> SU1 I wouldn't want that. No, I wouldn't. Because a great example I have is when I went for an infusion a few weeks back and the lady came and sat down next to me and when her nurse came up and said how are you she burst into tears because she was so ill. […] Being with somebody else, both professional and another patient, is fantastic. I mean, that's a great example of how important that is.

This kind of person-to-person conversation must be maintained, since without it healthcare becomes mechanistic and dehumanised:

> SU2 It kind of takes away the personal aspect of things. It's all a little robotic, isn't it? They forget to talk to you because they're too busy now looking at computers instead of at you.

> SU4 It's the two-way communication. It's the interaction. It's not just him being fed stuff and him going I don't need to see you because I've got everything here, you can sit there being quiet or something.

There is also a concern that the plethora of data that technology could provide is actually used:

> SU3 I'd be quite happy to fill something in but there's no point in doing that unless they were going to also look at it.

And used appropriately to supplement and enhance care, not to substitute the human care aspect:

> SP So there is that little bit of anxiety there about if we had digital recordkeeping and it was all on a screen would we then be starting to somewhat degrade that sort of personal talking to a person, you know, we're looking into their eyes and watching their face […]You want to be listened to as well. I mean, I think you want to know that you're listened to. […] Where [technology is] used to substitute it, I think that can be detrimental. So that's where I'd put the dividing line.

Participants are therefore very aware of the advantages as well as potential disadvantages of introducing technology into the care regime. Trust is indeed an essential foundation as McEvily et al. (2003) assert. But it is not transferred wholesale from one component in the overall healthcare process to another. There are limits, and to maintain that trust as organising principle, the overall service must be seen to improve, preferably to the benefit of all, with H2H interaction the main and deciding factor.

Demographics

In their meta-analysis of user response to technology, King and He (2006) found no difference in the behaviours of students as a test group and professionals. They did, however, accept that students and professionals did differ from the general public. In our small pilot, individual experience with technology and a willingness to work with it also differed across individual participants including those comfortable with technology:

> SU3 Well, despite my age I'm actually quite a geek really. […] I have run a website for a whole group of [people]. I have a very positive attitude towards technology

> SU4 [I'm] fairly comfortable with it, as comfortable as any non-techy member of the public

But with this comes an acceptance that there are risks, which do not in themselves necessarily stand in the way either of trust in technology or its adoption:

> SU5 I'd imagine there might be, I mean, there are people who won't use online banking because they worry about it. So I'd imagine there will be some people who wouldn't want to use it. […] I don't think so with that and I suppose if you stopped and worried about you'd be one of those people who doesn't ever use anything like Facebook. But generally the benefits totally outweigh the possible risk of things. I think it would be really useful to be able to look at all your medical records online but I know there are other people who think that's really scary

Strangely enough, it's not patients who are the most reluctant to embrace the potential of technology:

> SP We've found all sorts of cultural problems in trying to get both clinicians and students to see the worth of these things and to use the technology on a day to day basis.

So care is needed in respect of trust and technology adoption. It may simply come down to the fact that the motivation of these users as sufferers of a chronic and at times debilitating condition mediates their willingness to trust.

Experience

Other mediating factors may include existing usage or related experience with technology:

> SU3 Yes, I use it for, I mean, I'm all Apple based too I have an iMac and I have an iPad and I have an iPhone. And I have iCloud so whatever I do, in theory, is replicated on the other

Or specific services and applications:

> SU4 Well, the only thing I use, there's a thing called Patient App that my surgery happened to have. I don't know whether it's nationwide or whatever. Allegedly you can actually make a doctor's appointment but I don't think they signed up for that but they do alert me. So when I do have an appointment it pops up on my calendar so that's jolly useful. Because there's so many appointments taking over my life these days, that's always good. And I order, well, the meds that I get through my GP as against I get methotrexate delivered by Health at Home, because it's injections, that's another route. But I basically just use the app for that.

Even to the extent of individual involvement in getting the technology deployed and accepted:

> SU5 I was involved in setting that up and then looking after that as well. So that made my happiness with the internet greater, if that makes sense

Age

In addition, there may be age-related considerations. For instance, age and condition may reduce the importance of perceived risk in handling sensitive information:

> SU3 Well, as far as I'm concerned I'm at retirement age, I'm a [ACTIVITY] , I haven't got any life insurance, it's not particularly sensitive to me. I don't really mind who knows, if you see what I mean.

And of course, stereotypes may be misleading:

SU3 Well, despite my age I'm actually quite a geek really. I do digital artwork as well and I have run a website for a whole group of [people]. I have a very positive attitude towards technology

Physical health

But there are other factors which may affect the enthusiasm to embrace technology:

SU3 But the iPad is a lot easier when I'm very stressed because it's flat and I don't actually have to bend the wrists in the same way.

Or may need to be taking into consideration:

SU5 Yeah. That's the other thing with rheumatoid, if you're feeling really tired it's really easy to get brain fog and do something really stupid.

Cognitive impairment

Though ultimately it's not only physical condition that can be a gating factor; mental capacity may also have something to do with it:

SU3 And not being at all well, taking all that on board, it was quite complicated. So I couldn't actually swear to you how much of the complication was in the app or how much in my head or in the pills, you know, but it was challenging.

SU5 That's the other thing with rheumatoid, if you're feeling really tired it's really easy to get brain fog and do something really stupid.

This goes back to the comment made elsewhere (see *Fault tolerance* above) that in consequence the technology may also need to be forgiving towards its users.

In the preceding sections, the mediating factors associated with trust in technology and technology adoptions within the specific context of healthcare have been described. It is clear that these factors need to be taken forward with a wider population if an attempt is to be made to understand trust in technology in the complicated interaction of H2H and H2T found in healthcare management situations.

Concluding remarks

The Söllner et al. (2012) model of trust formation in respect of H2T interaction does have some validity from this modest pilot study. However, it is clear that the domain itself is rather more complex. Risk taking and fault tolerance, for instance, are accepted on the basis that ultimately service users trust that the whole process, including human agents such as the medical team, are benevolent towards them. Other aspects of TAM and HCI, namely usefulness and ease of use, seem to obtain for these participants. However, there is clear evidence that such features must also go together with convenience, either in terms of the service users' physical condition or to ensure appropriate information can be tracked.

Trust transfer is important, it is true. But again there is more to it. If technology can be seen to be beneficial to the service users, in terms of managing their condition or the everyday implications such as diary management, then they seem to be prepared to trust it. This comes with a significant caveat though: that same technology cannot be allowed to undermine or otherwise compromise the H2H interactions which are significant for sufferers of chronic conditions.

As one of the service users states:

> SU5 [I've] always been keen to try and find out from users, and they've had a user group for feedback, how they're finding it.

which of course is what social networks and virtual support groups are for, with the technology in support of the palliative effect of peer support (Haslam and Reicher, 2006).

So technology design in this area is not only about ease of use and usefulness. It must also take into account the background and expectations of potential users. Their condition itself may lead to physical or even cognitive disadvantages which would only exacerbate technology issues.

Trust in the healthcare environment therefore seems to be a complex interaction between the utility and convenience of that technology as it affects and supports existing human interaction. It is also about enhancing and developing the H2H interaction, saving time for quantitative or ill-remembered information gathering to allow for more effective and mutually satisfying H2H interaction. The technology should become an enhancement to and not a replacement for such interaction.

Interview Questions: Guide Given to Interviewess

Context setting narrative

"In this [interview], I'll ask you to consider your trust of technology, services and systems in the area of [CONDITION]. In particular, I will ask you [about (specific named app if one exists) / to imagine an app to help you manage your [CONDITION]."

Core questions

This will be a semi structured interview. Indicative questions will focus on the three main areas of app performance, process and purpose with prompts around different dimensions of trust.

"In this [interview], I'll ask you to consider three broad areas, which I'll call performance, process and purpose. Let's begin with performance, that is, whether a service, system or technology can do what it promises. Within performance, areas include a service's responsibility (that is, having the necessary functionality), accuracy, and reliability."

"Q1. What do you think about the performance of this app? In what ways does it meet/not meet your expectations?"

- Prompt on issues of: responsibility, information accuracy, reliability as necessary
- Prompt on cognitive, affective and behavioural aspects as necessary
- Get an idea of how trusting they are of the performance of the app overall

"Another area of interest is process, that is, the degree to which the processes of a service, system or technology are appropriate. Within process, areas include a service's user authenticity (that is, being able to act in your name), understandability, predictability, confidentiality, and data integrity."

"Q2. Do you think the processes behind the app are appropriate to allow the system to operate effectively? Why? In what ways do you think the processes are/are not appropriate?"

- Prompt about: user authenticity, understandability, predictability, confidentiality, data integrity
- Prompt on cognitive, affective and behavioural aspects as necessary
- Get an idea of how trusting they are of the processes of the app overall

"The final area of interest is purpose, that is, whether the intentions of the designer of a service, system or technology are benevolent. Within purpose, areas include a service's authorised data usage, designer benevolence, and faith (that is, its future reliability)."

"Q3. What are your thoughts about the purpose of this app in the context of supporting your care?"

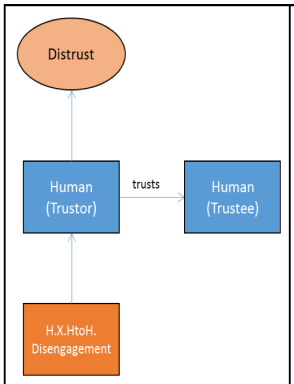
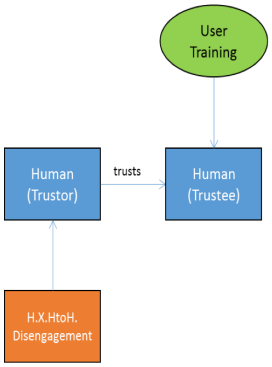
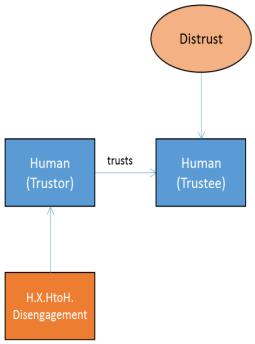
- Prompts on issues of: authorised data usage, benevolence, faith
- Prompt on cognitive, affective and behavioural aspects as necessary
- Get an idea of how trusting they are of the purpose of the app overall

Appendix III: Risk Models and Controls Added to OPTET

In the following diagrams, orange boxes show threats, blue boxes show actors, and green ovals show controls (interventions to address the risk).

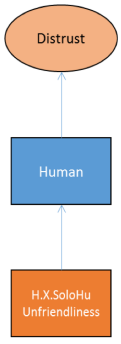
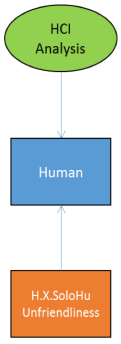
Threat 1: User Disengagement

Clinician disengages, undermining trust of pain sufferers.

		
A Trustee shows during an interaction outside the system that they are not engaged with the system in the way the Trustor expects. This causes the Trustor to lose interest in engaging with the system.	Threat can be controlled by training the Trustee to use the system in such a way that they meet the expectation of the Trustee.	Threat may be a secondary effect: if the Trustee doesn't trust the system, that would cause the disengagement that affects the Trustor. To control this, one must address the root cause – see below .

Threat 2: Unusable System

Possible cause of clinician disengagement.

A Human finds the system unusable and disengages from it.		Threat can be controlled by analysing how the Human will engage, and making sure the user interface allows them to do so in such a way that the system meets their expectations.	

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