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Abstract
This paper reports on system trust and interpersonal trust issues revealed in an embedded-case study of two telemedicine services offered by a teaching hospital. Consistent with McKnight (2005) perceived system competence was an important dimension of system trustworthiness. Drawing on representation theory (Wand and Weber, 1995) we observed: 1. Some clinicians feel telemedicine provides a better representation than they can achieve in conventional practice. 2) The ability to control specific technical features leads to increased representational quality, perceived system trustworthiness and usage. 3) Some clinicians adapt the telemedicine system to improve it. 4) Some users do not distinguish between the technology artifact and a human helper when judging system trustworthiness. We conclude with two key findings: 1) judgments about system trustworthiness interact with users' technical and clinical skills and 2) system trust and interpersonal trust are reciprocal.

Keywords: telemedicine, trust, system trust

1 Introduction

Trust is an essential lubricant for computer-mediated collaboration, including clinician interaction via telemedicine. In this paper we propose that interpersonal trust and system trust interact to affect system usage. We offer evidence from an embedded-case study of two telemedicine services, in dermatology and geriatric psychiatry.

In the information systems literature *interpersonal* trust has been studied in virtual teams and *system* trust has been studied mostly in e-commerce. However, questions remain. For example, do findings from studies of virtual teams generalize to IT-enabled collaboration among health care professionals? Is a consumer's trust in an eCommerce application comparable to a clinician's trust in a telemedicine application? How do interpersonal trust and system trust interact?

In this paper we examine system and interpersonal trust in two telemedicine services provided by a "hub" hospital. Our study addressed the following questions:

1. *What precursors affect clinicians' system trust?*
2. *How do specific telemedicine system features affect clinicians' system trust?*
3. *How do system trust and interpersonal trust interact?*

2 Interpersonal and system trust

In the information systems literature *interpersonal* trust has been studied in virtual teams (Jarvenpaa, et al., 2004; Jarvenpaa and Leidner, 1998). We adopt an oft-cited definition: "the willingness of a party to be vulnerable to the actions of another party" (Mayer, et al., 1995). Prior research finds that interpersonal trust reduces perceived information-sharing risk (Andrews and Delahaye, 2000; Brown, et al., 2004). Interpersonal trust is affected by one's propensity to trust (due to a theorized combination of personality traits and prior experiences) combined with beliefs about another party's competence (ability), benevolence (acting in the partner's best interests) and integrity (honesty) (McKnight, et al., 2002). Separate beliefs combine to form an "integrated" trusting belief (see figure 1). Furthermore, interpersonal trust is dynamic; it increases or decreases with experience (e.g., I perceive you to be trustworthy to the extent that you continue to prove yourself trustworthy in your dealings with me).

Paul and McDaniel (2004) found that distrust was an impediment to telemedicine use by clinicians at "spoke" hospitals. Perceived competence was a necessary but insufficient precondition for interpersonal trust, and perceived integrity and benevolence each needed to be at least non-negative.

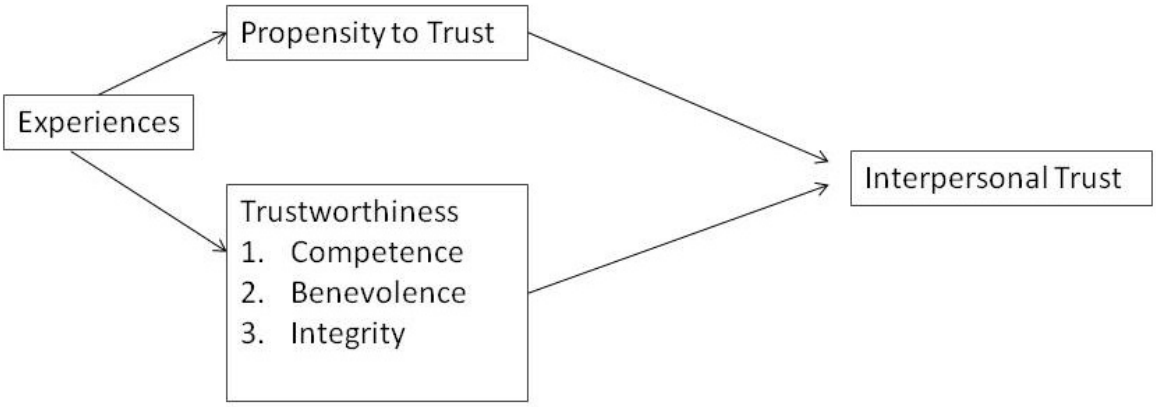

Figure 1: Interpersonal Trust

System trust has been studied mostly in e-commerce (Bolton, et al., 2008; Lippert, 2007, McKnight, 2005; Wang and Benbasat, 2005; Vance et al., 2008). An eCommerce study defined system trust as a "belief that the proper impersonal structures have been put in place enabling one party to anticipate successful transactions with another party" (Pennington, Wilcox, and Grover 2003, p. 201). We define system trust as *a willingness to be vulnerable to the "actions" of an IT application.*

One's propensity for system trust is affected by prior experience, computer self-efficacy (Compeau and Higgins 1995), and social norms (Bhattacherjee and Sanford, 2006; Burgoon, et al., 2000; Gallivan, et al., 2005). Some researchers consider beliefs about an application's "competence" (its capabilities) as more salient than perceived benevolence or integrity: "Because technology lacks moral agency, trust in technology necessarily reflects beliefs about a technology's capability rather than its will or its motives" (McKnight 2005, p. 330). Other researchers find that as users accommodate to

real or perceived technical constraints, they respond as if a system is human (Beaudry and Pinsonneault, 2005). So, possibly some users perceive systems as having traits of benevolence or integrity.

According to representation theory (Wand and Weber, 1995; Weber, 2004) the central purpose of an information system is to accurately depict real-world phenomena, although every information system achieves only an imperfect representation (Burton-Jones and Grange, 2008). To the extent that a particular system accurately represents a phenomenon (e.g., a monitor's display of a patient's vital signs data or video that clearly shows the patient's skin color and breathing), users see it as "competent." If it is reliable, a user might see it as having "integrity." A well designed interface might possibly lead a user to perceive it as "benevolent." As one observer notes: "Signals of well-done user interfaces and good vendor reputations will build trust. Reliable, dependable, quality IT performance is the key over time" (McKnight 2005, p. 330). Building on this work Vance, et al. (2008) examined two specific categories of trusting beliefs regarding m-commerce technologies: navigational structure and visual appeal.

System trust may be undermined if an application is unreliable or buggy. As with interpersonal trust, system trust is dynamic; it can wax or wane. If users feel an application does not provide the information they require, some will modify or work around it to suit their needs (Lamb and Kling, 2003). Systems thus interact with and evolve along with the human actors and institutional structures they serve (Baxter and Berente, 2007; Butler and Gray, 2006; Orlikowski, 2000).

3 Methodology and two cases

We report on two telemedicine services offered by a rural tertiary-care teaching hospital We utilized an embedded cases methodology and the constant-comparative method of analysis (Strauss and Corbin, 1998). Semi-structured interviews explored challenges and trust issues Interviews were recorded and professionally transcribed, and interviewers also took field notes. Transcripts were read and corrected, and contextual notes added to them. Four forms of coding were done:

- Factual coding, to capture key events and facts, which were triangulated against information in other documents or interviews.
- Comparative coding using previously-identified themes from earlier rounds of data gathering in this and other telemedicine studies.
- Open coding, to reveal new themes not seen in prior studies.
- Interpretation, revealing the broader meaning of events, actions and attitudes (Stake 1995).

After each researcher separately coded the transcripts we compared and consolidated them. Based on several rounds of analysis we offer evidence of how specific technology features affect system trust and interpersonal trust, and mechanisms that were utilized to improve both system trust and interpersonal trust among clinical collaborators, including generalist and specialist physicians, nurses, paramedics, and patients. We report next on findings from our study of tele-dermatology and geriatric tele-psychiatry services offered by a teaching hospital in a rural state. A nationally recognized

telemedicine leader, RuralHub has offered various telemedicine consultation services for more than ten years. Dermatology is the heaviest user for patient-present consultations, and geriatric psychiatry is a newer telemedicine service.

3.1 Tele-Dermatology for Prisoners

There is currently significant unmet demand for dermatology services. RuralHub tries to bridge this gap by offering dermatology consultations via telemedicine. Most are done by a single dermatologist to several prisons in a one-day-a-month clinic. RuralHub is paid for the expert's consultation with every scheduled prisoner, even if there are some no-shows. Since prisons have tight control over their inmates' schedules, the dermatologist views it as a win-win situation. He enthusiastically noted "*we know what we will get*" when he provides this consultation service each month. *"If someone is a bad actor and gets thrown in the hole … my hospital gets paid anyway."* In contrast, when the hospital offered tele-dermatology services to partner hospitals and clinics (a service which is no longer offered), scheduled patients often didn't show up and the expert would be "*sitting around in a room and waiting to be called*." So, distrust of unreliable patients caused this hospital to cancel a service in favor of one where the client (prison administrators) could be relied upon.

We were surprised that this physician was enthusiastic about telemedicine, since he described himself as a technology "dinosaur." He reported that examining patients from a distance via video conferencing is comparable to face-to-face examination:

> *"I must say, in looking at a level of confidence and accuracy, I feel like I can confidently decide what is going on 95 percent of the time or more. When I don't know, it is probably not because of not seeing, it is probably because it is something unusual and then I get biopsies for things like that. So I feel fairly comfortable with … having a big T.V. and looking close up and telling them how to move and how to position."*

The service utilized a chauffeur-driven system: a nurse or physician's assistant at the prison would manipulate the camera at the physician's direction:

> *"I find that it works very well… I can tell them to refocus, move around, how to view something. I can say, "let me look at his left arm or his right arm' … They do a good job. I come in and sit down, the TV comes on and I talk to patients … and it works. I am very happy with it."*

He added that he was "grateful for it" because if he were using store-and-forward technology instead of video *"I imagine (that would be) very technique driven and dependent on the photographer who takes the pictures and then sends them on."* This physician's appreciation of the system's adaptability and immediate interactivity (in the hands of a "chauffeur" with the necessary skills) increased his trust in the system.

After explaining that he felt the care he provided was comparable to what he would provide face to face, the dermatologist hastened to add several benefits of the system:

> *"Number one, you don't have people in chains in your waiting room. Number two, it is a lot cheaper for the prisons because they don't have guards and drivers spend the whole day transporting someone over, which can cost thousands of dollars. … Plus the security; the inmates don't have to leave the prison; there is no chance of escape."*

While neither prison guards nor physicians appeared to trust the prisoners, they did trust one another to show up as scheduled. The dermatologist offered another perspective when asked how he would feel if all dermatology consultations (to patients who are not prisoners) were done via telemedicine:

> *"The patients would not like it. People come in and we spend time with them… we get to know them and they have a nice social interaction… There are dermatology practices elsewhere in the country where they run a mill and they crank people through every five minutes… That is not very gratifying."*

While this physician felt that tele-dermatology was safe, valuable, cost-effective and comfortable for care of untrustworthy prisoners, he worried that for other populations the pressure to "crank patients through" could impair physician-patient relationships. Thus, his trust in the telemedicine system was situation-specific.

3.2 Geriatric Tele-psychiatry

At RuralHub psychiatry was launched after telemedicine services were already in place in vascular surgery, dermatology and several other clinical areas. We interviewed a psychiatrist and administrative and technical personnel. The psychiatrist described how he became involved. The Medical Director of Telemedicine had said to him,

> *"'Want to start a tele-psychiatry service? I'll bet you can't do it!' I wasn't interested in that at all, but he used a little reverse psychology… and it sounded like a challenge. I liked him a lot … and it's one of those things … you want to develop your colleague base as well as you can, so I thought, well, let me look into it. … And I've loved it."*

This quote hints that the psychiatrist was willing to extend himself to build a relationship with a colleague. Since he had an interest in elder care, he worked out arrangements with several rural nursing homes that were affiliated with hospitals that RuralHub already provided telemedicine services to in other clinical domains. The choice of nursing homes was propitious because Medicare requires that they be able to provide psychiatric consultations in a timely manner, yet many rural nursing homes *"are regularly in danger of defaulting on their Medicare obligations … because they can't get psychiatrists to come to them (or can't afford to have a psychiatrist on staff full time)."* At each nursing home a video camera is mounted on a wall with a pivot device. A nurse facilitator is present during tele-psychiatry consultations, and a social worker and several family members may also be present along with the patient. The

psychiatrist stated, "*It makes for a complicated but very interesting and satisfying interaction."* The psychiatrist controls the video camera from his office at RuralHub (unlike the dermatologist, who relied on a "chauffeur"). He appreciated that the camera is quiet and "*really not very obtrusive, not at all."* During the session he can zoom in on the face of the patient or a family member. This was very important to him:

> *"This whole telemedicine approach is superior in some ways …. If you're interviewing a patient (in a conventional consultation), there's a certain distance that you can get; closer than that is uncomfortable for someone. Without having binoculars on I can only see so much. But if I ... can zoom in on your face, I can see tears forming much sooner, I can see a twitch in the corner of the eye or the face. Just as interesting and important is this: Let's say you're my patient, I can be interviewing you knowing that I'm going to ask this next question that's going to be emotionally charged. I'll twist my camera over to the family member, ask the question, and look for their response. …We found that for those kinds of things, telemedicine might be superior … There's always been the feeling that you have to compare telemedicine to face-to-face, the gold standard. Well actually, maybe face-to-face should not be considered the gold standard in all cases."*

This physician also was pleased that the system helped him to interview patients who are hard of hearing, which is common among the elderly. Patients were given head-phones so they could adjust the volume yet "*the room doesn't get blasted …We get a big bang for our buck with the amplified headphones."* He further commented that a variety of patients who he worried would be reluctant to use this medium (including paranoid patients or those with dementia or other form of cognitive impairment) did not seem to mind at all. For example:

> *"Patients with, let's say, avoidant personality disorder, paranoid states, abuse survivors or trauma survivors: There's a feeling that they have a little bit more control over the environment. I joke with them sometimes, and say, 'Hey if you don't like this, just change the stations; you can listen to Oprah' … In some cases a tele-psych visit might be superior to a face-to-face meeting."*

The psychiatrist did identify one challenge on his end:

> *"If you look directly at the TV screen, it looks like you're looking down, so you have to train yourself to look at the camera rather than the screen, and it's not that easy to do; I forget to do it from time to time. But (thanks to a picture-in-picture capability) I see myself on the screen, and I can tell when I'm making good eye contact. We purposely disable that on the other side, so that little picture-in-picture won't be a distraction to patients, especially those with cognitive impairments."*

The psychiatrist appreciates the system's adaptability and is willing to make the effort to learn how to use it more effectively.

At one nursing home, the same nurse facilitator is in the room at every consultation, while at another nursing home different individuals play this role at different times. The psychiatrist had a mild preference for the former approach:

> *"It's easier with that regularly re-occurring RN, because I know her and she knows me; we've worked for a fair number of years together now. She knows what to expect, I know what to expect. … If I had my druthers, I would always have a dedicated nurse… who knows the stuff and who just does it so regularly that he or she is comfortable with it."*

4 Discussion

Interpersonal trust is affected by one's propensity to trust and perceptions about another party's benevolence, competence, and integrity. System trust is a controversial construct; prior research find that perceived competence is highly salient, but that some users might also ascribe the dimensions of benevolence and integrity to systems. Both system trust and interpersonal trust are dynamic. Our case study of two telemedicine services provided by RuralHub suggest some tentative answers to our research questions about how systems trust and interpersonal trust interact in telemedicine.

4.1 What precursors affect clinicians' system trust?

As briefly discussed in the literature review, previous studies explored the effect of *propensity to trust* on interpersonal trust. In our study we see hints of interesting and subtle issues related to propensity to system trust. An older dermatologist described himself as a "technology dinosaur" (low propensity for system trust). However, his trust increased due to the technical support he received from a spoke "chauffeur," who operates the camera in response to his requests. As the dermatologist gained experience with the system his trust in it grew; he reported that it was helpful and enjoyable to use. Had a chauffeur not been included in this process, the outcome might have been quite different. We note also that this doctor discontinued some tele-dermatology programs when other partners proved untrustworthy in providing patients at agreed upon times.

Thus, while we expected that low IT experience and computer self-efficacy would lead to low propensity to system trust and hence low system trust, we observed that the combination of chauffer-style technical support and strong interorganizational partnerships overcame this clinician's initially low propensity to trust.

4.2 How do specific system features affect clinicians' system trust?

System trust developed to a high level in both telemedicine services. Our findings suggest, consistent with McKnight (2005) that perceived system competence (the system's ability to carry out relevant tasks) was an important dimension of perceived system trustworthiness. Our data revealed four themes related to competence:

1. *Enhancing the practice*: The psychiatrist saw the system as competent and even better than working face to face in some instances, thanks to its ability to unobtrusively focus closely on a patient or another person, amplification that helps a patient hear better, and other features. Indeed, he asserts that for some

clinical encounters telemedicine should be considered the "gold standard". This suggests that a collaborative IT application can enhance quality to such an extent that users feel it provides a superior representation versus without the system.

2. *User control of IT:* Consistent with Komiak and Benbasat (2004), we observed that users' actual or perceived control over an IT application influenced their trust in it. The psychiatrist explained that his ability to remotely control the camera enhanced his ability to see and understand clinical details from a distance. The camera offered access to important information that he might otherwise miss, even if he were in the room with the patient. This response was directly related to his ability to manipulate the camera so as to zoom in on a patient's eyes or redirect the focus to a family member. We extend Komiak and Benbasat's findings by proposing that a user's ability to control specific technical features to improve sensory inputs leads to a better representation of the objects of interest, which leads to increased user trust in the system.

3. *IT adaptation:* Our findings reveal that if users believe an IT application does not competently provide the necessary information or provides an inaccurate representation, some find ways to adapt it to improve representational quality. When the psychiatrist recognized that the system impeded his ability to make eye contact, he compensated by checking the picture-in-picture. Realizing that this default picture-in-picture feature was a problem for patients, he compensated by turning off this feature on the patient's end.

4. *Competence is socio-technical:* Another nuance of system competency entails the use of an IT application with the aid of other people. The dermatologist commented on the telemedicine system's ability to provide him with accurate images. It is unclear if the image quality was actually due to the IT artifact (the system's competence) or due to the "chauffeur" at the remote site (the person's competence), or some combination of the two. In this judgment the doctor perceived that the "system" was trustworthy, and in this regard he did not seem to distinguish between the technology artifact and the human helper.

From these examples, it is clear that judgments about system "competence" interact with users' technical and clinical skills, and competence is not a simple dimension. Neither benevolence nor integrity were beliefs that contributed to users' assessment of system trust. Interviewees did not explicitly comment about system reliability contributing to trustworthiness. Administrators did inform us that the hospital's telemedicine systems are tested frequently and thoroughly. Since technical support personnel ensured system reliability, clinicians were shielded from many unpleasant experiences (such as needing to reboot and reconnect) and thus may not have thought about this presumably important aspect of system trustworthiness.

4.3 How do system trust and interpersonal trust interact?

In the two embedded cases we observed that as telemedicine applications proved to be reliable and well supported, they faded into the background and doctors focused on interpersonal trust issues and clinical practices. For example, as the psychiatrist became more adept at using the picture-in-picture feature he believed this improved his social

presence with the patient. From this observation we propose that when users encounter a high level of congruence between what is represented via an IT application and the phenomenon it represents, interpersonal trust comes to the forefront. When an IT application accurately and reliably depicts both social and physical cues, as in our cases, the user (psychiatrist and dermatologist) can focus on the other people taking part in the technology enhanced interaction (patient, family members, other clinicians).

4.4 Managerial implications

Our findings are consistent with prior studies that found that users of telemedicine systems and other collaborative IT applications must have at least a minimal level of trust in one another as well as trust in the system. Our study further reveals that the two forms of trust have tight reciprocal relationships to one another: as interpersonal trust strengthens, users become more tolerant of untrustworthy behaviors of a system, and as system trust strengthens, users report higher interpersonal trust. Therefore, before introducing a new system it is helpful to first examine the current level of trust users have in one another. These bonds can be strengthened prior to the introduction of a collaborative system through training and other relationship-building mechanisms.

Furthermore, organizations may need to be cautious in introducing unstable systems in higher risk environments and with less technologically sophisticated users. An unreliable system can lead to low levels of perceived system trustworthiness. This may have the unintended consequence that the level of trust among users, support staff or technicians also declines. Strong testing and live simulations can help ensure that a system will be deemed trustworthy. One caution is that because of the socio-technical nature of system use there may be overreliance on a new technology without recognizing the critical nature of support personnel (e.g., chauffeur) especially as less experienced users adopt these systems.

Managers also should recognize what a system represents and how users relate to these representations in actual practice. This goes beyond the concept of whether or not a system is considered useful. Rather, it encompasses users' perceived control over the system and their abilities to adapt it during use. Since systems can never perfectly represent phenomenon, there is a great need for such flexibility in use.

5 Limitations and conclusions

Our investigation explored clinicians' propensity for system trust, the impact of technical features on system trust, and the interaction between system trust and interpersonal trust. We observed evidence that perceived system competence affects system trust, but observed no direct evidence of perceived system benevolence or integrity. Further study is needed to explore whether these dimensions of system trust apply in other contexts or during various stages of use.

Specific technology features played important but varied roles. The psychiatrist appreciates the system's adaptability and his ability to control it. He feels the system offers him something he can't get in a regular consultation (see tears welling, closely observe a family member while asking the patient a question). This clinician actively learned how to use the system, adapted it to work more effectively, and used it to verify

clinical details; these steps helped to build his trust in the system. From this we find, consistent with Burton-Jones and Grange (2008), that to the extent that a system supports adaptation, learning, and verification it will be perceived as trustworthy. However, another clinician took a passive approach, relying on a technical chauffeur; yet he, too perceived the telemedicine system to be trustworthy. Thus, while verification may be essential to system trust, adaptation and learning may not be.

We also observed that feedback affects trust and that as system trust increases, the IT artifact becomes more transparent, to the point where interpersonal trust issues may be more likely to surface. This important finding deserves further study.

The study revealed that the dermatologist values his technology "chauffeur" and the psychiatrist values his relationship with a nursing coordinator who he sees regularly via video conferencing. This clinician believes his patients trust both him and the system, and that some patients may even be more comfortable using this mode of consultation than when they are face-to-face with him. An important limitation of this study is that we were not able to interview patients or clinicians at the spokes, which would give a clearer picture of the dynamics of interpersonal trust. An important related limitation is that we chose to look across two cases (albeit in the same hospital) rather than conduct a single in-depth study of one telemedicine service. The disadvantage is that we do not have a complete 360^0 view of stakeholders' perceptions in each example; however we believe that we identified more interesting and novel findings from this research strategy. For example, our findings revealed that while a propensity to trust technology may be affected by computer knowledge and self-efficacy, it is not a linear or complete relationship. A technology "dinosaur" had low skill yet high system trust, in part because he trusted his "chauffeur."

Prior research find that organizational trust (which we did not explore) can "trump" interpersonal trust, in that people from different organizations may distrust one another as individuals yet place faith in the others' organization (Zaheer, et al., 1998). This aspect deserves further examination, particularly in sorting out the interplay among system trust, interpersonal trust and organizational trust. We also did not study so-called "swift" interpersonal trust, which develops quickly in some temporary teams (Jarvenpaa, et al., 2004; Meyerson, et al., 2006). When role clarity is high (as in movie production), team members reportedly rely on rapid judgments about others' trustworthiness. Since role-based interaction is common in medicine, swift trust may also occur in this domain. In our study it did not seem to be a factor in dermatology and psychiatry, which involve non-urgent care. Research also finds that if another party is a "weak tie" (not a close friend or colleague), beliefs about their competence are most salient (Levin and Cross, 2004). Further research is warranted, to learn whether swift interpersonal and/or system trust have impacts when telemedicine takes place under time pressure, such as in emergency medicine, and involving participants who are weak ties.

Information technologies continue to evolve. The World Wide Web was launched around 1994, so today's medical students, interns and residents are comfortable using systems for many individual and shared tasks. System trust issues that might have prevailed twenty years ago are thus likely to play out differently over the next few decades. As hospitals turn increasingly to telemedicine and other interorganizational IT

applications there will be many further opportunities to study the interplay among system trust and interpersonal trust.

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