Do I Trust My Medical Professional on a Virtual Consultation? Biosensors, Human Computer Interaction and Trust-Building

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***Abstract*— Telehealth usage in 2021 was 38-times higher compared to the average pre-pandemic level [1]. Patient interaction with a medical professional mediated by a screen – whether it's a computer screen, tablet screen or a mobile phone screen - has implications for trust-building [2], which, in turn, impinges on health outcomes [3]. In this paper, given that over 55% of communication is non-verbal [4], we focus on understanding how screen-mediated non-verbal cues – eye-movements, hand gestures and facial expressions - influence feelings of trust. This understanding is sought through the design of an experiment where we vary non-verbal cues in standardized images/videos and examine the effects on feeling of trust as reflected not only in self-reports by subjects but also in more objective data captured by biosensors.**

Keywords*— *biosensors, human computer interaction, trust-building

I. Introduction

The pandemic has resulted in an explosive growth in screen mediated (virtual) meetings or interactions. As the linguistic anthropologist, Elizabeth L. Keating [5] notes, in moving from face-to-face interactions to screen-mediated interactions, we lose key pieces of non-verbal information. In drawing on Goffman [6, 7], Keating further notes that "we lose the ability to observe others observing us, because we often don't know where their gaze is directed. (They're looking at their screens, not us)." This ability is of particular import since about two-thirds of the social meaning of a conversation emanates from non-verbal communication. The dissipation of important pieces of non-verbal cues impinges on feelings of trust – especially in the patient-healthcare-provider relationship. As noted by Kimball and Morgan [8], "…on a very basic subconscious level, we can see a person in front of us but cannot locate them in space. This strain on our proprioception increases our stress levels — and, for many patients, visiting a doctor is already a stressful proposition." This 'low quality' communication is not conducive to trust-formation and adversely impacts receptivity to healthcare provider's advice and treatment, as pointed out by [3]; "Trust is typically associated with high quality communication and interaction, which facilitates disclosure by the patient, enables the practitioner to encourage necessary behaviour changes and may permit the patient greater autonomy in decision-making about treatment."

This paper focuses on how the most elemental non-verbal cue, viz., just a portrait-icon of the person one is interacting with or will prospectively interact with, impacts trust-levels, when this interaction is mediated through a computer screen. A closely related paper [9] examines the differential impacts of nonverbal cues in a web-based chat (with only "semantic information" being the source of non-verbal cues and no visual information about the person one is interacting with is available) versus face-to-interactions, where the face-to-face interactions occur between human-human and human-robot. The human-human interactions help uncover non-verbal cues that are linked to trust, where trust is measured in similar fashion to the standard trust-game in experimental economics [10]. The robot is then programmed with these non-verbal cues for the human-robot interactions. Results show higher trust-levels for relevant non-verbal cues in human-human and human-robot interactions compared to web-based chat interactions. Our paper is different not only in that it examines the effect of a visual non-verbal cue in screen-mediated interactions on trust-levels, but it also seeks to understand the underlying biological mechanisms with the help of biosensor technologies.

II. Hypothesis

This paper tests how an elemental non-verbal cue – such as a visual of the person one is interacting with – impacts trust-levels. So, our hypothesis is that a scenario where one can see the picture of the person one is interacting with will produce higher trust than the scenario where there is no picture as a result of a positive emotion.

III. Testing Methodology and Apparatus

To test our hypothesis the methodology of experimental economics is employed with the following key features:

a) Controlled environment in a laboratory setting

b) Randomized control trial (RCT) approach to test hypotheses

c) Monetary incentives as the underlying anchor

Interaction between individuals (subjects) is mediated by a computer screen and enabled with the commonly-used software; z-tree [11]. Eye-tracking devices, cameras, and the face-reading software [12] for detecting emotion complete our testing apparatus.

IV. Design of Experiment

We leverage the standard trust game a la Berg et.al. [10] to measure trust. At the beginning of the experiment,

participants are randomly assigned to the role of either trustor or trustee. The experiment will consist of multiple sessions. Each session is comprised of two periods. At the beginning of period one, the trustor receives an endowment of US$10 and makes a decision on how much of the endowment to transfer to the trustee. The experimenter triples the amount that is transferred to the trustee. In period two, the trustee makes a decision on how much of the tripled amount is to be transferred back to the trustor. Trustor and trustee are made aware of their respective net amounts from the session. The actual transfers of trustors constitute a measure of trust, and the reaction of the trustees, a measure of trustworthiness. This two-period game (with payoffs) is diagrammatically presented in figure 1.

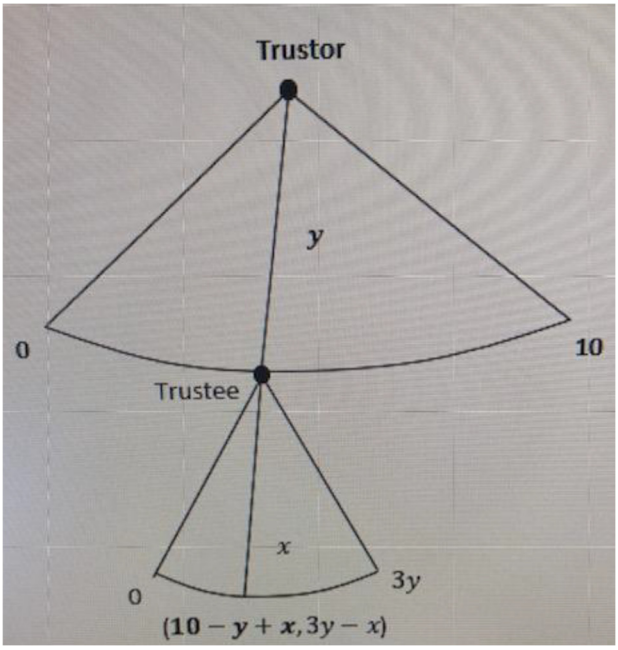

Figure 1. Two-period game (with payoffs)

Participants who have been assigned to the role of trustor complete the task in the BiometriX Discovery Lab of the Romain College of Business on a computer monitor screen. The trustor's console is equipped with eye-tracking, camera, and face-reader technologies. Participants who have been assigned to the role of trustee complete the task in the Griffin Experimental Economics Lab on a computer monitor screen. All participants' screen-mediated interactions are enabled using the z-Tree program through intranet.

The Control condition follows the standard trust game where the trustor and trustee remain anonymous are not identified by any portrait-icon

In the Treatment condition, in period 1, the trustee selects one out of four facial (gender-neutral) emojis/portrait-icons expressing, respectively, emotions of happiness, anger, neutrality and sadness. This portrait-icon is revealed to the trustor prior to the trustor making the decision to send money to the trustee. The trustor then makes the decision on how much money to send back to the trustee. In period 2, the trustor decides how much of the tripled amount to return to the trustee.

After the completion of the two periods, the trustee is given a survey asking them whether they know the trustor they were matched with prior to both of them participating in the experiment. A demographic survey is also be given to all participants.

During the entire experiment, eye-trackers are activated on the trustor's side in the BiometriX lab to determine the trustor's attention allocation. The expressed emotion during the decision-making process of the trustor will be analyzed as well using Noldus Facereader software. The trustee's portrait-icon will be analyzed in Noldus Facereader to determine the expressed emotion in the Treatment condition.

V. Data Collection and Results

We ran a pilot study in April, 2023 at the University of Southern Indiana. Eight subjects were recruited to complete a trust game for 4 rounds. Among the subjects, 62.5% were females and 37.5% were males. The pilot session lasted for 20 minutes. One of the rounds was randomly selected for the actual payment. The average earning of subjects was 12.75 USD. During the experiment, webcams were used to collect facial expression data. Subjects were randomly assigned into the role of either trustor or trustee. Their roles were fixed throught the experiment. Based on the data from the pilot session, we have the following findings:

a) A portrait-icon, on average (across types), generated greater trust compared to no-icon. This is reflected in the finding that trustors seeing portrait-icons, on average, sent 7.25 USD to the trustees compared to sending only 5.25USD, on average, when no portrait-icon was observed.

b) Among the portrait-icons sent to the trustors, the portait-icon showing a sad emotion engendered the most trust. On average, 8 dollars out of an endowment of 10 dollars was sent by trustors to the trustees.

c) Facial-expression analyses reveal that the portrait-icon for sadness generated the highest level of emotion anong the trustors compared to any other portrait-icon and compared to the non-icon condition. Importantly, in this case, the trustor's emotion mirrored that of the trustee – one of sadness – indicating that the sadness portrait-icon had the power to activate the highest relative level of empathy.

VI. Conclusions

This paper demonstrates how the most elemental non-verbal cue of a portrait-icon in a screen mediated interaction can generate a higher level of trust compared to the exclusion of a non-verbal cue. Further, it it revealed that a portrait-icon reflecting some degree of sadness, by activating greater levels of empathy than portrait-icons associated with other emotions (including happiness), generates the highest level of trust. To our knowledge, this is the first paper to shed light, scientifically (without relying on self-reported reasons), on the underlying mechanism through which a certain non-verbal cue produces a certain level of trust. This has important implications for strategically managing non-verbal cues in telehealth and other kinds of screen-mediated interactions.

Future studies can expand this pilot research by simulating health-related contexts in additional controlled laboratory environments and utilizing field data from telehealth services. First, recruiting a health care provider to record a simulated telehealth consultation would allow for more extensive analysis of responses to computer-screen-mediated communications. In this study, there is the opportunity to manipulate the healthcare provider's eye gaze and facial expressions while controlling for the information communicated, environmental cues, and vocal tone. The purpose is to determine if variations in a healthcare provider's eye gaze and facial expressions influence participants' emotional responses and trust in the healthcare provider. In this study, participants' facial expressions are analyzed using AFFDEX software to measure emotional responses while eye-tracking technology captures which video elements attract participants' attention. A survey utilizing validated psychological scales to measure affective responses and trust capture self-report measures from participants. This study design follows the research of Helou et al. [13] which solely focused on a doctor's camera gaze and utilized Global Consultation Rating Scales to capture participant responses. Second, a field study using doctor-patient interactions via telehealth would provide greater external validity. The goal of such research would be to analyze patient affective responses to the telehealth experience, via facial expression analysis, combined with survey responses following the experience. This form of research can connect subconscious responses to telehealth video experiences with cognitive responses. As such, it would add to research which indicates positive affective responses to human-to-human interaction are an important determinant of telehealth success [14]. The challenge of such research is to develop a scientific study that meets all patient confidentiality required by the Health Insurance Portability and Accountability Act of 1996 (HIPAA) in the United States. One such study using recorded patient videos of emotional-focused-therapy videos has been identified [15] , but is unclear what approval would be needed to evaluate doctor-patient telehealth video consultations. Most studies assessing field data in telehealth use employee follow-up questionnaires, which do not allow for biometric data from the interaction to be analyzed.

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