Sistemas y Tecnologías de Información

Actas de la 9ª Conferencia Ibérica de Sistemas y Tecnologías de Informacion
Barcelona, España
18 al 21 de junio de 2014

Vol. I – Artículos

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Álvaro Rocha
David Fonseca
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Luís Paulo Reis
Manuel Pérez Cota

Artículos de la Conferencia

Artículos de los Workshops

Fourth Iberian Workshop on Serious Games and Meaningful Play (SGamePlay)
Sixth Workshop on Intelligent Systems and Applications (WISA)
2nd Workshop on Information and Communication Technology in Higher Education: Learning Mathematics (TICAMES)
First Workshop on Applied Statistics and Data Analysis using Computer Science (ASDACS)
First Workshop on Augmented Reality and Wearable Computing (ARWC)
First International Workshop on Internet of Things (IoT)
First International Workshop on ICT for Auditing (WICTA)
First International Workshop on Learning Analytics (WLA)

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Tomo 1

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Sixth Workshop on Intelligent Systems and Applications (WISA)

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2nd Workshop on Information and Communication Technology in Higher Education: Learning Mathematics (TICAMES)

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First Workshop on Applied Statistics and Data Analysis using Computer Science (ASDACS)

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Prefacio

Este libro contiene los artículos aceptados para su presentación y discusión en la 9ª Conferencia Ibérica de Sistemas y Tecnologías de Información (CISTI'2014), organizada por la AISTI (Asociación Ibérica de Sistemas y Tecnologías de Información), La Salle - Universitat Ramon Llull y Universidad Politécnica de Catalunya, durante los días 18 al 21 de Junio de 2014, en Barcelona, España.

La Conferencia Ibérica de Sistemas y Tecnologías de Información (CISTI) es un foro que reúne académicos y profesionales, sobre todo del espacio ibérico y latinoamericano, proporcionando el intercambio de conocimientos, nuevas perspectivas, experiencias e innovaciones, así como la discusión de los mismos, en el área de los sistemas y tecnologías de la información. Uno de los principales objetivos es promover la dinamización de la simbiosis que tiene faltado entre la academia, la sociedad y la industria.

La Comisión Científica de la CISTI está formada por un grupo multidisciplinar de expertos o fuertemente relacionados con el área de los Sistemas y Tecnologías de la Información, constituida por cerca de trescientas personas, a las cuales les ha correspondido la responsabilidad de evaluar, en un proceso de revisión "ciega", los trabajos recibidos en cada una de las temáticas de la conferencia.

En CISTI'2014 fueron recibidos más de 300 trabajos, oriundos de 28 países, en forma de artículos, artículos cortos, artículos póster y artículos de empresa. Además, también se han recibido artículos para el Simposio Doctoral y artículos para los diferentes Workshops sobre temas más específicos. En total fueron recibidos más de 400 artículos.

Los artículos aceptados para su presentación y discusión durante la conferencia son publicados en libro y en CD con ISBN. Los autores de los mejores artículos seleccionados serán invitados a extenderlos para su publicación en revistas indexadas en ISI/JCR, Scopus, DBLP, etc., en el libro TICAI (TICs Aplicadas para el aprendizaje de la Ingeniería) del IEEE y en otras publicaciones que estén dispuestas a ello.

Finalizo, agradeciendo a todos los que directa o indirectamente han colaborado con la CISTI'2014 (autores, comisiones, patrocinadores, revistas, etc.), participando en la consolidación y expansión de un foro de sistemas y tecnologías de información de gran relevancia para el espacio ibérico y latinoamericano.

Álvaro Rocha
Universidade de Coimbra
Presidente de la Comisión Coordinadora

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A model for Human-computer Trust

A key contribution for leveraging trustful interactions

Sonia Sousa, Paulo Dias
Universidade Aberta
Lisboa, Portugal
sonia.sousa@uab.pt, paulo.dias@uab.pt

David Lamas
Tallinn University
Tallinn, Estónia
david.lamas@tlu.ee

Abstract — **This article addresses trust in computer systems as a social phenomenon, which depends on the type of relationship that is established through the computer, or with other individuals. It starts by theoretically contextualizing trust, and then situates trust in the field of computer science. Then, describes the proposed model, which builds on what one perceives to be trustworthy and is influenced by a number of factors such as the history of participation and user's perceptions. It ends by situating the proposed model as a key contribution for leveraging trustful interactions and ends by proposing it used to serve as a complement to foster user's trust needs in what concerns Human-computer Iteration or Computer-mediated Interactions.**

Keywords - Human-computer trust; Interaction design; Engagement; Participation; Collaboration.

I. INTRODUCTION

Living in an increasingly technology-reliant world has made people more dependent on technology for carrying out everyday activities. This tension has direct implications on how technology influences society's fundamental values. This is reflected in the attempt to develop strategies to provide a more trustworthy digital society and is expressed in the European Commission's agenda for year 2020. [19]

While agreeing that we became part of a digital crowd when clearly supporting the development of trust and security technology, we miss the need for focusing on Human-Computer Interaction. In fact by missing this one aspect of trust we might end up creating systems that end up being designed for computers rather than humans. One such example is Google Buzz's failure due to the lack of informing users that their list of contacts is being made public by default, which caused significant criticism leading to undermining user's trust and eventually shutting down the service. [7]

At the same time and within both the domains of Human-Computer Interaction and Computer-Mediated Interactions we see clear efforts to move beyond tackling the pragmatic challenges of interactive systems (such as effectiveness and efficiency) to address less tangible and mostly hedonic qualities. Human-computer trust (or perceived trustworthiness) can be considered one such hedonic quality [20].

This tendency illustrates that designing for trust requires not only a focus on understanding the nuances, such as security, privacy, and reputation, but above all it requires understanding the subtleties of the perception of trust. We believe that (trustworthy) trust fostering systems must be built upon trust-enabling qualities drawn from the social science [6] and that embedding trust requires acknowledgement of the psychological social dimensions that come attached to trust represent one of the most important component in today's systems design. As, this eventually leads to a greater understanding of how individuals interact with systems and the extensive impact of trust in design for sustainable and self-regulated interactions.

However, due to the complex and challenging nature of this task, as from one hand trust is a rather complex and personal subject, from another a computer forms a rather complex mixture of many different components that need to be considered (devices, networks, operating systems, applications, service providers, etc.). We envision the proposed model of Human-Computer Trust use as a complement to better inform how certain trust mechanism can be internalized and perceived by the users when interacting with and through a computer.

II. TRUST AS A SOCIAL PHENOMENA

Trust is referred in a relatively broad set of constructs. In social science it is a topic addressed in many fields of knowledge like sociology, economics, philosophy, psychology and social psychology. Trust as a social phenomenon contemplates a complex two-way relationship between individuals that are constituents of a society. Trust as a social phenomena emerges from three main social contexts: [38, 15, 25, 26, 22, 11]

- An interpersonal or organizational context – we may trust a particular individual more than others;
- A specific social situation – we may put our trust in a work colleague, sharing work related sensitive information, but not with our personal thoughts;
- A specific social cultural context – we are required to trust our family doctor with our health problems in spite of not knowing him or her personally.

Trust as a social phenomenon continues to be a rather complex topic to address in the social science field, making it difficult to compare or to provide clear insights about the nature of trusting relations. This cross-disciplinary nature of trust has prompted a considerable debate about what is trust, how it is influenced, and how it is represented, making it difficult to define narrowly, or just as a "single static" concept. Trust carries many meanings and plays a role in divergent contexts.

While sociologists tend to see trust as structural in nature [18, 22], or in terms of behavior [16] or even as a moral choice [15; 38]. Psychologists examine trust as a personal attribute and as behavioral intention (relates to the predict acceptance of behaviors by others). [13] Social psychologists tend to view trust as an interpersonal phenomenon [10, 28, 41], a social structure to provides interpersonal relationships, known as institution-based trust or willingness to trust if within a more social physiological perspective. Economists are more inclined to view trust as a rational choice mechanism, as a game (the game theory) [31]. The philosophic perspective sees trust and distrust attitudes as something that affects our feelings and the way we think and act [4].

TABLE I. TRUST AS A SOCIAL PHENOMENON FRAMEWORK

Sociologist's	Trust is a reflection of behaviours, choices and decisions	Represents a intention
Psychologist's	Trust is an attitude or intention	Represents a personal attribute; an observable behaviour.
Socio psychologist's	Trust is an interpersonal phenomenon	Represent a social structure
Economist's	Trust is a rational choice mechanism	Represent a rational decision

III. HUMAN-COMPUTER TRUST

Computer scientists tend to separate above approaches into two distinct domain definitions: operational and internal. One reflects the tendency to examine trust from a more operational standpoint, observing it as a sort of rational choice vs a measurable risk. This operational approach requires a rational decision based on a moment in time and the knowledge of the possible rewards for trust or lack of it (by trusting we enable higher gains and by not trusting avoid potential losses). Examples can be found in literature that address issues like trust management or computational trust, with definitions often associated with security, reliance and privacy [12, 1].

Another perspective on defining trust, popular among social psychologists, assumes that trust is an internal state [38, 15]; and from this perspective trust is a state of belief in the motivation of others. Such a view often relates trust with the willingness to cooperate. Examples can be found in literature that address issues like computer-supported collaborative work, communities of practice, design for trustful interactions, social capital, organizational trust, and technology-mediated social participation [3, 27, 28, 29, 8, 41, 11].

The difference between these perspectives is in how researchers sees trust dynamic which depends on the type of the relationship that is established through, or with other individuals.

A more operational approach, usually describes it dynamic as a simple isolate interpersonal event situated in a specific moment in time and context. Trust is a measurable risk. Trust in this context can reflect, for example, either a willingness to share knowledge or not.

Although this view can be useful to design reliable systems, which aim to prevent information threat risks, it is not sufficient for designing interactive systems where individual's trust comes across many dimensions (including time), like what occurs when interacting with social networking systems or peer-production platforms [24, 6].

A. The dynamics of Trust

Trust represents a calculative orientation toward risk [2]; by trusting we assume a potential gain, while by distrust we are avoiding a potential loss [17]. Thus, a violation of trust usually lies not in a simple isolated interpersonal event, but rather it is a significant event that is likely to have impact on the parties and on the relationship. Trust is then, transitive and changes over time. Trust is a reflection of a state of mind; a confidence and one's predisposition to trust another. This based on a set of perceptions of other (a society, a person, and or a technological artifact) as 'trustworthy' [11, 25, 29]. Formed by a combination of observable behaviours, which includes perceived affect and cognition based behaviours [5].

Trusting represents a reinsurance element, which come associated with certain properties that help to support users intended behaviours. And the ability to observe those reinsurance elements assure a balance between individual's commitments and the risk involved; a parameter that support the Trust vs distrust asymmetry described by Gambetta [17].

This reinsurance mechanisms can be combine through a set of measurable observable behaviours that emerge from social and technical categorizations, e.g. group or individual's political, economic and social orientation [15], or from institution-base properties [21, 28]}; or even from certain social qualities like honesty, benevolence or reciprocity [14]. This reinsurance mechanisms give individual's a structural assurance for be predispose to trust. Such predisposition, further in time can be reflected in individuals attitudes, for example as a trusting bound.

In sum, the trust dynamic contemplates a subtlety decision that lies on the complexity of the game that he or she find herself playing as Bacharach [2] describes it. Within this '*game'* trust comes associated with a time anchor proprietary, represented by an initial trust moment (we trust or not) and an ongoing trust moment (trust can be weaken or strengthen over time) [24]. More, the identification of trustworthy making qualities (what underlies people's trust beliefs) is not enough to induce trust, it is needed also to understand if this signs of trust are to be trusted (attitudes) [2]. What addressees the question of the reliability of trustworthy making qualities, especially with the increased omnipresence of peer-production platforms, like Wikipedia, Google docs or Wordpress.

B. A Model of Human-Computer Trust

The proposed model of Human-Computer Trust depicts trust as a construct informed by 7 (seven) individual qualities, such as: motivation, willingness, reciprocity, predictability, honesty, benevolence, and competence, and determines the extent to which one relates with one's social and technical environment [35, 36]. This model was achieved by an extensive literature review on trust as a social phenomena and

was complemented by a participatory design procedure that resulted in:

- The Identification of most common trust notions (design of a concept map);
- A personal unified view of possible trust implications in today's online community structures (participatory design session with experts and users) [31].

The design of the model also complemented by the unification of Davis's and Venkatesh's Technology Acceptance Models [9, 40].

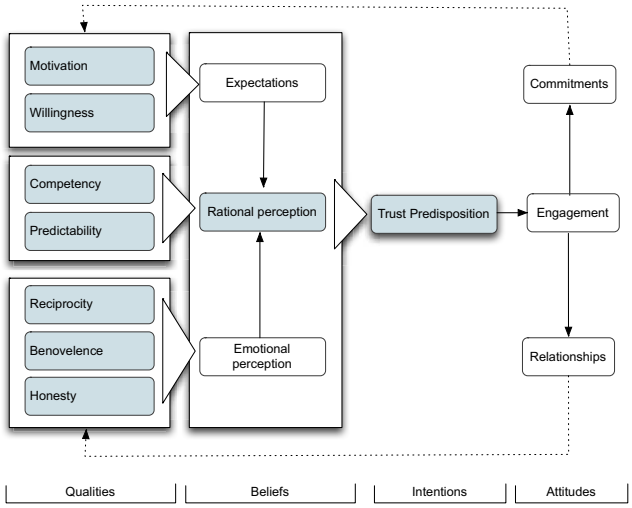

Figure 1. A model of Human-Computer Trust.

The resulting model (after validation) takes into consideration certain observable qualities of trust. Qualities that support users' beliefs when sharing, communicating and engage in give and take action online. It provides as well insights into what leads users to construct a set of intentions (predisposition to trust) that result in more or less engaging experiences. These experiences reflect user attitudes to engage, i.e. commitments towards establishing a relationship through the computer, or with other individuals.

IV. VALIDATION PROCESS

This validation procedure aggregates two distinct empirical approaches.

1. One aimed to select the predominant factors (indicators), which according to users determine the extent, to which one is predispose to share, relate and communicate with another socially online. This was questioned across a wide spectrum (close to open) of possible online relationships; the close relationships were represented by friends, family, and colleagues; and the open relationships were represented by Teachers, acquaintances and strangers). A principal component analysis was performed herein to detect possible redundancy. [37]
2. The other empirical approach was achieved by conducting a set of small studies (performed over the past few years). It main aim was to validate de interdependency of each connection proposed in the model. Each case study used the model as a research lens and established relations that linked trust with qualities of online interactive systems, like openness [33], privacy [23], and collaboration [34].

This research ground was set in an higher and secondary education environment. Predominate **Instruments** and **procedures** used to perform these studies included online questionnaires, diaries and observation sheets. Data collection was conducted within the European context; majority of the participants were students from countries such Estonia, Portugal, Finland, Romania and Norway.

A. Results on selectting the predominant trust indicators

To select of the predominant factors (indicators) a survey was randomly conducted among 480 individuals. The majority of these individuals were students and teachers who interact online in a frequent base. [37]

This survey was randomly distributes throughout different Portuguese universities. Four-hundred and eighty (480) subjects answered the survey and from those Three-hundred and forty (340) were consider for analysis, the remaining where either incomplete or where consider biased. From those 53.5% of the participants were teachers and 46.5% were teachers.

A confirmatory factor analysis was applied to select the predominant factors. This factorial analysis process included questions that assessed individuals' trust predisposition towards another in three distinct settings, (1) to engage in online relationships; (2) to engage in sharing (give and take) actions; and (3) be willing to communicate online. Each question was framed across a wide online relationships spectrum.

Results revealed that in the majority of the cases individuals' became more predisposition trust and engage in online relationship if they will be able to observe qualities like respect, honesty, and reliability. Or be able to observe benevolent attitude, like empathy and sympathy (be kind and be friendly). Or even appreciate the fact of knowing the person, or at least share similar interests or similar social identities.

Results strongly support the Trust in what regards the predisposition to share (give and take actions] within the following qualities: to be able to observe qualities like reliability, transparency and honesty, respect and empathy or predisposition to share.

In what regards the important qualities to be predisposed to trust in an online communication, individuals stressed the need to be able to observe qualities like honesty, transparency, predict other intentions, to receive support, feel secureness and share common interests.

B. Results on visualize possible correlations between trust and openness

This study was deployed among Higher education students with experience in using open-base blogging systems for

education purposes. Thirty-two (32) subjects answered this survey. All subjects were from in Estonia[1].

Results indicated that user's attitudes towards openness and sharing depends very much on the information they share and with who they share that information. For example, they claim to don't mind to share learning information openly with everyone (if they feel control on what they share in open environments). In fact 37.93% of the students claimed that this could contribute to make the learning processes become more reliable and credible [33]. But, they had shown strong concerns with whom they share specific personal information, like assessment information, grading results, comment on assignments, or teacher's feedback information. In this case they prefer to keep the information private by default and be free to choose with whom to share.

Regarding the question "what make you trust in a particular person online" the answers showed a tendency to consider vey important issues like: if the person is honorable (34,48%) and capable to respect them (31,03%). It is also important to know that person with whom they are going to communicate with (37.93%) as well as if they share similar interest and preferences (34.48%).

Regarding students' predisposition to engage in a give and take actions, the most considered relationship qualities like sensing honest behaviour (48,28%), sense that they are sharing information with a reliable source (37,93%). Also, a sense of mutual respect and affinity (31,03%); be willingness to share in another quality (85,52%) and feeling empathy and sympathy (41,38%) are considering important qualities as well.

The most important quality to be predisposed to trust in an online communication process included to know how they behave, like friendly and transparent behaviours (44,83%); and honest (44,83%). Another is to fell secure (34,48%) and be able to predict other intentions (51,72%). As well as having a sense of belonging (27,59%) and mutual respect (37,93%) are important qualities.

C. *Results on visualize possible correlations correlations between trust and and privacy*

This study was deployed among secondary education students in Estonia, with no or little experience with open-base blogging systems. Fifty-two (52) subjects answered this survey. Regarding their previous knowledge on privacy issues 54% of the respondents revealed that they never had *e-safety courses* and 27% of the inquired claim they had *unofficial e-safety training* with parents or friends [23].

Results revealed that user's who are more aware of potential threats of privacy tend to be stress more the need to be assured of that the interaction environment is trustworthy, i.e. need to perceive the system and the people who interact in it as trustworthy. For example, a negative correlation was found between subjects' believe that it is safe[2] to share working related resources in a open environment and their believe that teacher's feedback (r=-.253*) and grading information (r=-.282*) should remain private by default. Same regards with those subjects who agree that teachers should always make extra efforts in providing support (r=.416**), and those who don't like that everyone can read their coursework online (.412**), or those who believe that it is safe (i.e. I can control who will read or have access to the information) to read teacher feedback in close learning environment.

Again positive correlations were found between subjects who feel that by keeping their homework submissions public, students will cheat and plagiarize more, and those who claim that is very easy to post anonymous comment on the Net (r=.262*), and those who believe that is very easy to post comments about a "friend, teacher/school" in the web using a false name (r=.320*). Similar beliefs were found among subjects, that tend to agree that teachers should always make extra efforts in providing support (r=.416**), with those who don't like that everyone can read their coursework online (.412**).

D. *Results on visualize possible correlations correlations between trust and collaboration*

In this case we use the teacher role as a research lens to observe possible relations between trust and collaborative activity patterns. We observe this correlation in three main issues, the relationship between individual's predisposition to trust and their attitudes towards collaboration [34].

The observed course was a "Technology Enhanced Learning" course, and was part of a European project called CoCreat [3] – "Enabling Creative Collaboration through Supportive Technologies" (http://let.oulu.fi/cocreat). Most activities performed in the course involve collaborative tasks, collaborative thinking and reflection. The course was deployed at a distance and included students and teachers from four (4) different European countries, Finland (University of Oulu); Norway (Norwegian University of Science and Technology Trondheim); Romania (Valahia University of Targoviste); and Estonia (Tallinn University).

The main achieved results revealed that trust in fact could influence collaborative behaviours. This results points to three main aspects (1) observing how learners perceive others intentions in a given context, (2) observing learner's commitments changes towards a particular activity (level of cooperation) and (3) observing learners perceptions towards

[1] Estonia is consider to be a peculiar country in terms of ICT use, as at the high school level the new National Curricula states an obligation for every school to have an e-learning environment. At the level of universities and vocational schools there are a lot of choices of open and non-open solutions to choose from, e.g. Wikiversity, Moodle, Blackboard, IVA, LeMill, WordPress, etc. \cite{EITF12}.

[2] By safe in this case we mean, "I can control who will read or have access to the information".

[3] Project main purpose was to find new solutions for promoting creative collaboration in terms of new and innovative learning models based on social media and mobile technology. In the course students were initially divided into small groups (from 4 to 9 students maximum) and different tutors were assigned to the groups. All learning activities were design and coordinated by a teacher who coordinate overall group activities.

the use of the communication mediums for learning purpose (reactions, intentions of use and actual use).

Results also reveled that the trust predisposition factor is important to motivate other to participate. The results indicated that those who shown more willingness to interact (easily engaged in online activities) had more success in perform collaborative activities and in foster groups collaboration. On the other hand, individual competency and their appetency to be engaged in online relationships aren't always related (this was clearly reflected during group synchronous communications). Although social engagement clear defined the participation, less social engaged students showed a tendency for follow those who were more actively engaged and show that those students only contributed if requested to.

Contradictory to what was expected open or close activities seamed less important for ensure the success of the group support and articulation. On the other hand qualities like reciprocity, kindness and benevolence were important attributes to ensure students bound and work articulation. Overall group-working methods differentiated from group to group, though in the end the majority of the groups achieved pretended results. As well as groups first activities were relevant to set the work climate and to establish future working actions (know how to behave and to observe other intentions and attitudes). Major group concerns regarded the task previsibility, e.g. predict what actions will be needed to be taken into account to ensure a successful collaboration. In return, system predictability and it perceived competency were important attributes for selection of artifacts to communicate and use in their collaborative activities.

V. Final Considerations

The aim of the paper was to propose and assess the expressiveness of a Human Computer Trust model. This model addresses trust in computer systems as social phenomena, which depends on the type of relationship that is established through the computer, or with other individuals.

We believe that the proposed model can effectively serve to describe how certain trust mechanism can be internalized and perceived by the users in what concern trust in computer systems as social phenomena, which depends on the type of relationship that is established through the computer, or with other individuals.

We also foresee it to be used for example by experts to serve as a informed complement on leveraging trust-enabling qualities drawn from the social sciences in what concerns Human-computer Iteration or Computer-mediated Interactions.

In this sense we perceive it future use from two main potential applications. One possibility is to inform the design process in which regards to the possibilities or attributes that could facilitate trust-enabling interaction processes. [32] Another possibility is to serve or complement the user experience evaluation process, for example it can be further developed into a heuristic set for Human-Computer Trust, as suggested by Vaananen [39].

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