Do you trust technology? An exploratory investigation on the concept of trustworthiness and the role of memory

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Abstract

Memory may differ depending on the presented stimuli, for example, whether the stimuli are trustworthy or untrustworthy. Meaning, within those stimuli some things may grab one's attention more, leading to enhanced encoding and better recognition in a later stage. Recognition has played a key role in studies involving faces by recognising and detecting cheaters from non-cheaters. The aim is to check the recognition not only towards faces, as well as the role of the attitude. Hence, this study's exploratory questions: (1) does memory play a role in recognition of untrustworthy stimulus compared to trustworthy stimulus – faces, scenes, and devices; (2) does attitude towards technology affect people's ability to recognise a trustworthy and untrustworthy device? There were 84 participants in this study. The expectation of this study – there is a trend that people would recognise the untrustworthy objects better than trustworthy. Based on the results, it cannot be said and related to what was stated in previous studies that people do have like a cognitive mechanism focused on cheater detection, allowing them to distinguish between cheaters and co-operators better (Cosmides, 1989; Cosmides & Tooby, 1992) due to insignificant difference. It has been only shown that memory play a role in the recognition of trustworthy and untrustworthy stimuli, but people are equally good/sensitive at recognition, however, with some trends towards recognising better different stimuli. Results about the effect of attitude towards technology on recognition showed no effect on recognition. Therefore, attitude is a non-influential factor towards trustworthy and untrustworthy objects, especially, devices recognition.

Introduction

Technology plays a big part of people's lives and that field is still developing, increasing the potential interactions between humans and technology (Roy, Dewit, & Aubert, 2001). It is found and being used in various forms, as well as in many fields. It supports people in their everyday life or help perform different tasks, from easy to complex, for instance, online shopping. Any electronic device like smartphone is considered as technology as well. Also, healthcare is strongly dependent on technology, as it has many medical devices and online systems that are being used either by medical staff or patients or both. Nevertheless, technology is widely used and dependent on, therefore, there is a necessity for any involved party in human-computer interactions (HCI) to trust in technology they are using that it will function and produce results as expected (Borsci, Buckle, Walne, & Salanitri, 2018; Salanitri et al., 2015). Hence, it is essential to define trust, variations, and degrees of it, as well as possible factors that influence people's trust towards technology.

Usually, when people are investigating trust, it can be described as one's willingness to trust the other involved party because of its characteristics (McKnight, Carter, Thatcher, & Clay, 2011; Rousseau, Sitkin, Burt, & Camerer et al., 1998). Trust is referred as trust in people or human-human interactions, but also as trust in technology or human-computer interactions (Aljazzaf, Perry, & Capretz, 2010; McKnight et al., 2011). Kelton, Fleischmann, and Wallace (2008) suggests four different categories of trust: (1) individual – I trust; (2) the interpersonal – I trust you; (3) the relational – You and I trust each other; and (4) the societal level – We all trust. As previously mentioned about the increase of HCI, interactions and trust are shifting more from human-human interactions towards HCI, therefore, it is essential to define trust more from a technological aspect. Human-human trust is different than human-computer trust (McKnight et al., 2011; Salanitri et al., 2015), however, some characteristics can be applied to

both (McKnight, Choudhurry, & Kacmar, 2002; Lipper & Michael Swiercz, 2005; Salanitri et al., 2015).

Human-computer trust can be described in three different levels. Firstly, as a set of beliefs that an individual has towards a specific technology or system before experiencing it. Secondly, trust is based on the relationship between human and technology, and, lastly, trust is dependent on the increasing experience with a specific technology (Borsci et al., 2018). Although there is various information about trust towards technology and more than one definition or description of it, essentially, the information leads to three main beliefs about the attributes of a technology – (1) functionality, (2) helpfulness and (3) reliability (McKnight et al., 2002; McKnight et al., 2011; Lankton, McKnight, & Tripp, 2015; Salanitri et al., 2015).

Functionality, helpfulness, and reliability are technological counterparts to a theoretical framework that consists of attributes that are related to trust in human-human interactions: (1) Functionality-Competence, (2) Helpfulness-Benevolence and (3) Reliability-Predictability (McKnight et al., 2002; McKnight et al., 2011; Lankton et al., 2015; Salanitri et al., 2015). All these attributes are not directly used or referred to this study, however, as it is about trust towards technology, brief definitions of beliefs about the attributes of a technology are described.

Functionality refers to a technology to be able to do certain tasks (McKnight et al., 2002; McKnight et al., 2011; Salanitri et al., 2015). Regarding helpfulness, it means that technology has help functions that are hoped to be helpful, when certain tasks or activities are in process (McKnight et al., 2002; McKnight, 2005; McKnight et al., 2011; Salanitri et al., 2015). Predictability and reliability are rather as straightforward as previous attributes and are similar in both types of interactions – people hope that the interacted party is predictable or reliable (Giffin, 1967, McKnight, 2005; McKnight et al., 2011). In other words, a belief or the

perception that a technology is working properly (McKnight et al., 2002; McKnight et al., 2011; Salanitri et al., 2015).

Distrust, mistrust and untrust

Associated with the concept of trust, there are also terms as distrust, mistrust and untrust. Sometimes, those terms can be interchangeable and can be referred as the shortage of trust (Marsh & Dibben, 2005), however, still some differences exist amongst them. Marsh and Dibben (2005) defined distrust as a negative form of trust and mistrust as misplaced trust, while Allen & Wilson (2003) referred to mistrust also as a form of negative trust. It has also been stated that trust should be scaled from negative distrust to positive trust (Bartkus & Davis, 2009) or that these terms should be parallelly measured from low to high (Lewicki, McAllister, & Bies, 1998). According to Kramer (1999), a factor that can play a role in these terms is suspicion, and, regarding mistrust, it would be an experience of unmet expectations. In addition to factors that affect trust and can lead to distrust, attempts to control and monitor others are listed (Hochschild, 1983; Piccoli & Ives, 2003). Considering these terms as negative forms of trust, they can have an effect in adoption of technologies (Levy, 2015), as well as leading to weakened relationships between human and technologies and increased suspicions (Zand, 1997).

Importance and factors of trust

Due to increased use of technology – by users, companies etc. -, trust plays an essential part as it is a crucial factor for the success of technologies (Hansen, Saridakis,, & Benson, 2018) and for the reputation of organisations, technologies etc. (Jarvenpaa, Tractinsky, & Vitale, 2000). Additionally, it affects product adoptions and potential mass adoption and production (Yamamoto & Lambert, 1994).

There are multiple factors that may affect an individual's trust and expectations towards the use of technology. Consumers create certain heuristics that may aid them through all the information and process (Jacoby, 1984; Scammon, 1977). Within heuristics, there are things such as brands (Hutter, Hautz, Dennhardt, & Füller, 2013), capabilities and skills of a technology, and also goes deeper into an individual's level of likeliness and perception – aesthetics of a product, prices, as well as one's experience, if any, their attitudes towards certain products or technology in general. Taking all this into account, one's overall trust towards technology is related to many concepts and factors and have to be explored deeper.

Trust in technology

Research on trust in technology is a rather new topic that is being studied more, but, currently, there is not a clear framework on the factors affecting people's trust before and during the human-computer interactions. However, there are some theoretical and empirical studies that showed that trust in technology can be supported or prevented by the perceived usability of the system (Roy et al., 2001; Salanitri et al., 2015).

In the paper by Lankton, McKnight, and Tripp (2015), trust towards technology and potential factors are shown by two main points – (1) how technologies vary in their perceived "humanness" and (2) developing trust in technologies differently due to perception in "humanness" (more human-like criteria or more system-like criteria). In other words, the more human-like the technology is, the stronger the influence of human-like trusting beliefs, and the more system-like the technology is, the stronger the influence of system-like trusting beliefs.

Research by McKnight, Carter, Tatcher, and Clay (2011) showed how initial and knowledge-based trust in a specific technology may differ. Initial trust proposes that persons expand their trust to an unknown interacted party (trustee) when a person relates a certain trustee with an institutional mechanism or familiar context. In addition, these findings in this

research suggest that when people rely on knowledge-based trust, they tend to make decisions based more on trusting beliefs about certain characteristics of a technology, rather than on institution-based beliefs. In relation to previous sections, this study also implies that trust is an important concept and that trust in technology should be studied further and deeper (McKnight et al., 2011).

Memory, recognition, and previous studies

Another aspect that can play a role in trust and trust towards technology is memory. Memory is an information processing system that entails the following: first, briefly keeping information, while simultaneously working with it – working memory; second, episodic memory, meaning, remembering episodes of one's life; third, semantic memory, which refers to general world knowledge (Spielman et al., 2018). Memory is a set of three processes that are also necessary stages in the learning process – encoding, storage, retrieval (Melton, 1963, Spielman et al., 2018). All processes consist of further subparts, but, for the sake of this study, the focus is only on the relevant parts.

The first process is encoding, which is the initial experience and learning of information. Once the information from the outside world is received, the brains start to label it and link it with other information and existing concepts. The second process is storage. When a certain information is encoded, it has to be put in storage. But for a memory to be successfully stored, first it has to go through three different phases – sensory memory, short-term memory, and long-term memory. Sensory memory receives brief sensory events and short-term memory (STM) processes sensory memory; however, short-term memory storage lasts around 20 seconds only. The last part of storage is long-term memory (LTM) and, in short, its capacity has no restrictions. All this leads to the last process – retrieval -, which entails terms like recall and recognition (Spielman et al., 2018).

Retrieval can happen once encoding and storing have been done. During encoding people encode the received information in different ways (linking, associating) that can enhance the retrieval process. Recall is the most often used term, when it comes to retrieval, but recognition is about identifying previously learned information, as well as recognition entails comparison (Spielman et al., 2018).

Memory may differ depending on the presented stimuli, for example, whether the stimuli are trustworthy or untrustworthy. Meaning, within those stimuli some things may grab one's attention more, leading to enhanced encoding and better recognition in a later stage. Recognition has played a key role in many studies involving faces by recognising and detecting, for example, cheaters from non-cheaters, which can be related to as untrustworthy and trustworthy. Two studies have implied that humans have like a cognitive mechanism focused on cheater detection, allowing them to distinguish between cheaters and co-operators better (Cosmides, 1989; Cosmides & Tooby, 1992). In experiments by Mealey, Daood and Krage (1996) and Oda (1997) participants looked at pictures with faces that were fictitiously assigned as either trustworthy or untrustworthy, or pictures with individuals labelled as co-operators or defectors, accordingly. The results showed that the recognition of untrustworthy faces or individuals as defectors was higher than trustworthy or co-operators. This indicates that people are more likely to recognise cheaters better than non-cheaters. Meaning that people's memory processes are more sensitive towards cheaters, memory plays a part in detection and that the role of memory should be explored further than only human faces.

Yamagishi (2003) explored a similar concept but with pictures of real cheaters and co-operators. He performed four slightly different experiments within his study, and the overall results of them indicated that there is a difference in looks between cheaters and co-operators, as well as that people recognise faces of real cheaters better than faces of real co-operators. These differences could be due to various factors like personality traits or certain beliefs etc.,

which, hence, affect people's trust towards something – in this case, faces. This study also indicates that people can spot some certain cues of cheaters' faces. Based on this, it could be checked further whether this can be applied towards different trustworthy and untrustworthy pictures, such as scenes and technology/products.

These studies imply that, generally, people are good at recognising cheaters, even when looking at pictures. Based on the literature, the ability to recognise cheaters for people seems to be more important than recognising co-operators/non-cheaters. It is also suggested that being able to identify untrustworthy information, products etc. may benefit more than identifying what is trustworthy (Yamagishi, 2003).

Aims of the study

As previously stated, and suggested by other studies, trust in technology is a rather new topic and should be studied further. The current study is built upon previous studies, involved in an ongoing study on trust and the data will be gathered regarding the mechanism of trust. Considering the previously mentioned and the literature, it is attempted to explore if, similar to the experiments regarding cheating and cooperation, trustworthiness and untrustworthiness could be discriminated before the receiving information regarding different types of stimuli: faces, scenes and technology/devices. In particular, to explore the role of people's memory ability in people's performance in this experiment. In addition, what is the role of attitude towards technology, when recognising a trustworthy and untrustworthy device? Therefore, exploratory questions are as follow:

1. Does memory play a role in recognition of untrustworthy stimulus compared to trustworthy stimulus – faces, scenes, and devices.
2. Does attitude towards technology affect people's ability to recognise a trustworthy and untrustworthy device?

Methods and analysis

Design

In this study, an experiment was created and carried out using PsychoPy3 software. The experiment was given to the researcher by the supervisor Dr. Simone Borsci. Before and after the experiment, an Informed Consent (see Appendix A) was used, as well as a questionnaire survey was used that included - Demographic characteristics, Attitude towards Technology/Dependency on technology (Edison & Geissler, 2003), Big 5 Personality Traits (International Personality Item Pool, n.d.), Trust in Technology (McKnight et al., 2011) (see Appendix D). Informed Consent and the survey were created using an online software package Qualtrics. Attitude was measured on 5-point Likert scale from Strongly Disagree to Strongly Agree (see Appendix D) and were recoded into values from 1 to 5, accordingly. The experiment and its procedure were approved by the Ethical Committee of the University of Twente (Request nr. 200125).

Additionally, previous studies, as well as this study, are based on signal detection theory as they involve responding as correctly as possible to the same or different stimuli, in order to calculate sensitivity, while taking into account bias (Macmillan & Creelman 2004).

Participants

A total number of 84 participants (Male: 42, Female: 42, Age Mean: 28, SD: 12, Min: 19, Max: 73) have been recruited by convenience and snowball sampling (participants help recruiting other participants), and researchers use their own experience and knowledge for participant selection (Everitt & Skrondal, 2010). Inclusion criteria for participants were to have intermediate language proficiency in English to be able to successfully fill out the questionnaires.

Materials

At first, an Informed Consent was made for this experiment (see Appendix A). As mentioned before, for the experiment the program PsychoPy3 was used, and it was created prior to this research containing a set of images of flags and 120 images from three datasets; (1) 40 images from the Chicago Face Database (CFD) (Chicago Face Database, n.d.) that contained images of male and female faces, which were rated either as trustworthy (20 images) and untrustworthy (20 images) faces (see Fig. 1 for an example and see Appendix B for more details). "Extensive norming data are available for each individual model. These data include both physical attributes (e.g., face size) as well as subjective ratings by independent judges (e.g., attractiveness)." (Chicago Face Database, n.d.).; (2) 40 images from The Socio-Moral Image Database (SMID), which is a systematically validated stimulus set (Crone, 2016) that included photographic images of scenes rated as morally positive or morally negative – 20 images in each category; (3) 40 images from Consumer Product Safety Commission (CPSC.gov., 2020) regarding trustworthy (20 images) and untrustworthy (20 images) products. The dataset (3) was created with devices that were reported as problematic and dangerous to people's lives (untrustworthy), and that are on the market since 2017 and were never reported for issues or risks in usage (CPSC.gov., 2020).

Figure 1

An example of a trustworthy face (on the left) and of an untrustworthy face (on the right)

Additionally, a questionnaire was developed, which consisted of questions about demographic characteristics, as well as including three more item-scales for this study: (1) questions regarding the attitude towards technology and their dependency on it (Edison & Geissler, 2003), (2) the McKnight questionnaire for Trust in Technology (McKnight et al., 2011), (3) finally, questions about the Big 5 Personality Traits - extraversion, agreeableness, openness, conscientiousness, and neuroticism (International Personality Item Pool, n.d.) (see Appendix D).

Lastly, an Acer Aspire V3-771G laptop, as well as other laptops by other researchers or participants (for more details refer to the next section) were used for the testing.

Procedure

At first, a participant was briefly informed about the experiment and then they signed the consent form online (see Appendix A). The experiment had two stages. The first stage consisted of a round, where participants were exposed to a set of images of flags – 20 flags in total - for 3 seconds each. Afterwards, they viewed a different version of this set of images, in which a random number of flags had been changed for other, new flags. Participants were then asked to indicate by buttons 'Y' and 'N' on a keyboard whether they recognized the flags they saw earlier or whether those flags were new. After this round, the experiment proceeded to the second stage. In this stage, the participants viewed an array of visual stimuli which displayed 60 randomly presented images of faces, scenes, or various forms of technology (devices).

Participants viewed these images from this stage in random order, and afterwards took a compulsory 30 minutes break. During the break, all participants performed the same task - watching a TedxTalk - The power of vulnerability (see Appendix C). After this break, similarly to the previous stage, the participants viewed a different version of the previous list of visual

stimuli and needed to indicate by buttons ‘Y’ and ‘N’ on a keyboard whether they recognized the images or not.

After the experiment was completed, the participants were asked to fill out a questionnaire through Qualtrics, which included questions about demographics and statements regarding their attitude, trust towards technology, dependency on it, and questions regarding the Big Five personality traits(see Appendix D).

Due to COVID-19, some changes had to be made in the procedure. Meeting with people in person was not possible with everyone, therefore, the experiment had to be performed also remotely by using internet calling applications - Skype, Google Hangouts, Microsoft Teams or Zoom. In the cases of online calling, the researcher used a function ‘Share screen’ that allowed the participant to give an answer about the images shown on the researcher’s screen, while the researcher was registering their answers by buttons ‘Y’ and ‘N’ on a keyboard. Additionally, another method was giving the full instructions of setting up the experiment on participants’ computers (installing PsychoPy3, doing the experiment and sharing the files with the researcher afterwards).

Data analysis

Since attitude towards technology was recoded into numerical values, so that this variable can be used for this analysis, attitude was measured as a mean value per participant.

Sensitivity was calculated as the discriminability index (d'), which represents the distance between the Signal and the Signal+Noise (Macmillan & Creelman 2004) – the ability to discriminate whether the stimulus has been seen before or not. Increasing values of d' refer to a better ability to discriminate between signal and noise for both d'(trustworthy) and d'(untrustworthy). Values below the 0 (zero), usually, indicate that participants were bad detectors (performed several mistakes), from 0 to 1 that they struggled to discriminate, from 1

to 2 that they were able to discriminate appropriately, and over 2 that they were particularly good, as indicated by Macmillan and Creelman (2004). This index was estimated by using the number of recognitions of new stimuli as false alarm (FA) – proportion of 'NO' trials to which subject responded 'YES' - and the number of recognitions of the stimuli presented for the second time as the hit rate (HR) – proportion of 'YES' trials to which subject responded 'YES'. d' was calculated and adjusted in line with the indication of Macmillan and Creelman (2004).

To explore the differences between the ability to recognise trustworthy and untrustworthy stimuli, an ANOVA, including all the pictures and all the types of stimuli (faces, scenes and devices) in which trustworthy and untrustworthy stimuli is a within subject factor, and the d' of the pre-test (flags) is a covariate is performed. Depending on the results of ANOVA, a regression of d'_pre-test (flags) on d' for trustworthy and untrustworthy stimuli can be made to tell if there is a difference in memory ability and/or per type of stimuli.

Groups of good recognisers of trustworthiness and untrustworthiness were created by estimating Delta - by subtracting the d' of each subject in the recognition of trustworthy objects from the d' they obtained in recognising untrustworthy objects. Hence, creating Delta value for each participant for all objects together and each stimulus separately – DeltaOverall, DeltaFaces, DeltaScenes, DeltaDevices. Negative values up to 0 were assigned to good detector of trustworthy, from 0 to the highest positive value were assigned to good detector of untrustworthy, and value 0 was assigned to equal (equally good at recognising trustworthy and untrustworthy). Descriptive statistics (Frequencies) of the d' can display whether people have a higher d' for trustworthy or untrustworthy.

To explore how attitude towards technology affect people's recognition, a regression analysis with an individual factor – attitude – was performed. In addition, due to newly created groups of Deltas, an ANOVA was run.

Results

The following table 1 displays mean and Std. Deviation values of all *d′*. It is visible that mean values vary from 0.8426, which is for *d′*_FaceTrust, to 1.5090, which is for *d′* of pre-test (flags), as well as variations in Std. Deviation – from 0.388 (*d′* of pre-test) to 0.591 (*d′*_FaceTrust).

Table 1

Descriptive Statistics - mean and STD values of all d′

	N	Mean	Std. Deviation
*d′*_pre-test (flags)	84	1.5090	.38747
*d′*_testOverall	84	1.3597	.51309
*d′*_Trust	84	1.3040	.50770
*d′*_Untrust	84	1.3463	.50093
*d′*_Face_Trust	84	.8426	.59082
*d′*_Face_Untrust	83	.9046	.54303
*d′*_Scenes_Trust	83	1.3140	.47605
*d′*_Scenes_Untrust	84	1.1944	.56637
*d′*_Devices_Trust	82	1.1407	.47866
*d′*_Devices_Untrust	83	1.1508	.52247
Valid N (listwise)	81		

Differences between the ability to recognise trustworthy and untrustworthy stimuli and the effect of attitude on recognition are being done by running 2-factor Generalised Linear Model-

Repeated Measures with *d′* as dependent measure and with *d′*_pre-test (flags) and the measure of the attitude as covariates. Results show that there is no significance within-subjects, hence people are equally good/sensitive at recognising trustworthy and untrustworthy stimuli, but, as seen in Table 2, there is a significance between subjects, meaning that *d′* differs from 0 (the intercept) and one of the covariates (*d′* of pre-test) also differs from 0. This indicates that there is an effect, because *d′* of pre-test enables people to discriminate correctly between the objects, but there is no difference between the sensitivity towards recognising untrustworthy and trustworthy objects, meaning that people are equally good. However, this does not reject that memory ability is affected by trustworthy and/or untrustworthy stimulus, memory does play a role in recognition of trustworthy and untrustworthy stimulus. Regarding attitude, the results (see Table 2) show that the effect is not significant, thus attitude towards technology has no effect on difference between recognising better untrustworthy or trustworthy objects.

Table 2

Role of memory and attitude on d′

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	1.611	1	1.611	4.588	.035
Attitude	.019	1	.019	.055	.815
*d′*_pre-test (flags)	4.836	1	4.836	13.769	.001
Error	28.449	81	.351		

Deltas are used to run a frequency analysis, with which it is possible to differentiate, how many people are better at recognising untrustworthy objects than trustworthy objects. The following

figures represent the recognition in overall, towards faces, scenes, and devices. Figure 2 shows the distribution in percentages. It is visible that 1.2% are equally good/sensitive at recognising untrustworthy and trustworthy objects, 44% are better at untrustworthy objects, and 54.8% are better at trustworthy. This indicates, that, in overall, people are better at recognising trustworthy objects.

Figure 2

People's distribution in percentages whether they are better at recognising trustworthy or untrustworthy objects

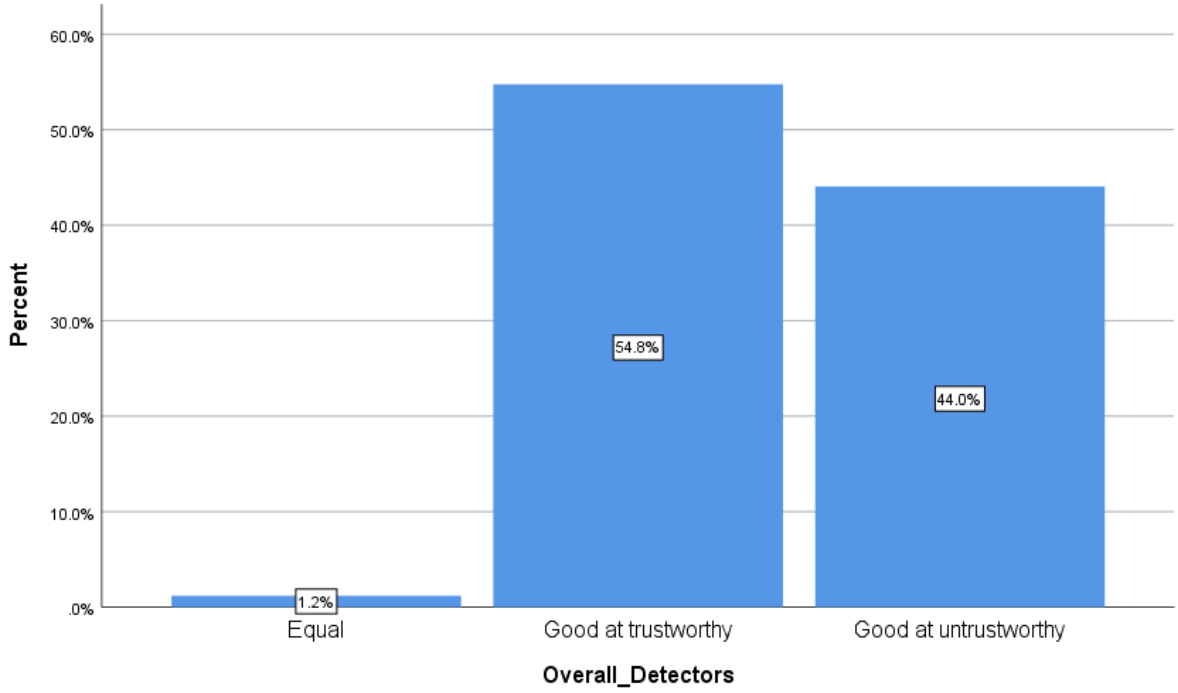
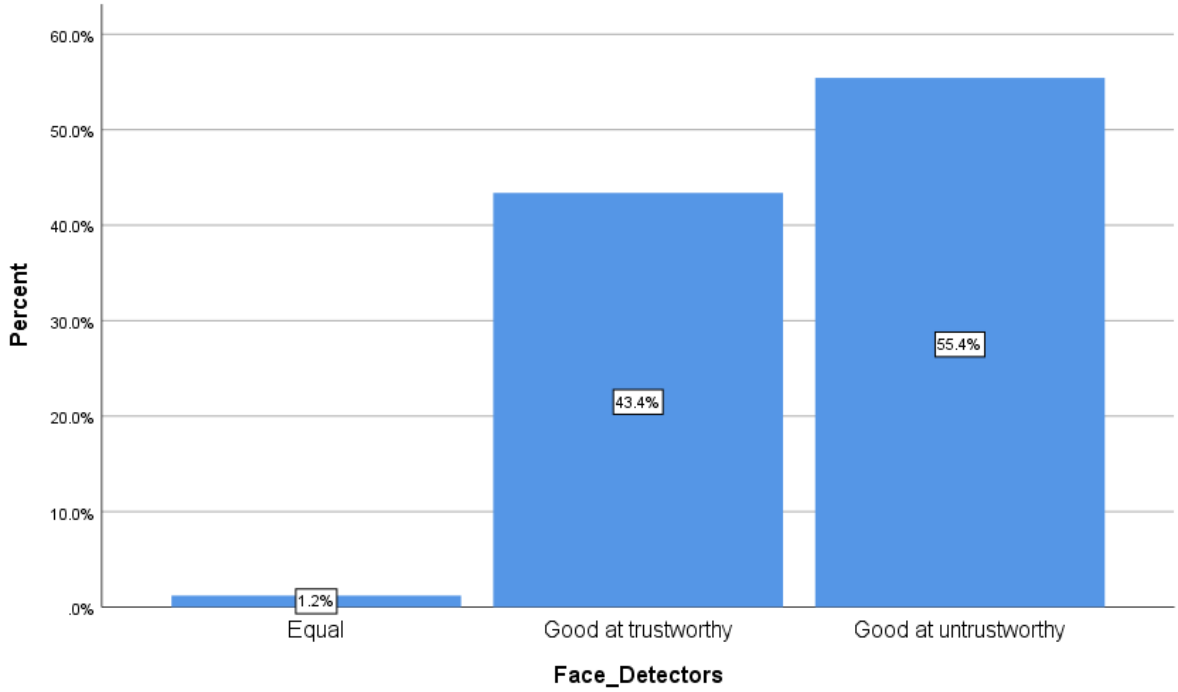


Figure 3 represents the distribution in percentages of recognition towards faces. It shows that there are 55.4% participants better at recognising untrustworthy faces, 43.4% better at recognising trustworthy faces, and 1.2% that are equally good/sensitive, indicating that people are better at recognising untrustworthy faces.

Figure 3

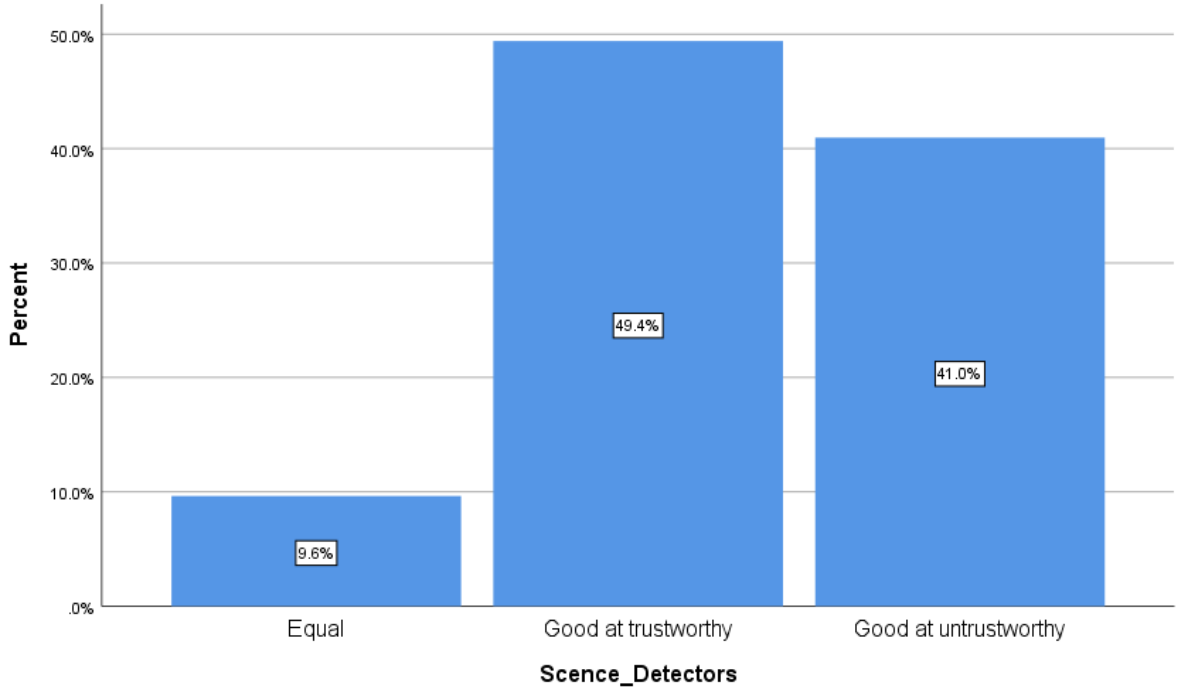
People's distribution in percentages whether they are better at recognising trustworthy or untrustworthy faces



Next figure (Figure 4) displays how good people are at recognising untrustworthy and trustworthy scenes in percentages. In contrast, there are 9.6% people who are equally good/sensitive at recognising untrustworthy and trustworthy scenes, 41% are better at recognising untrustworthy scenes, whereas 49.4% people are better at recognising trustworthy scenes. This means that people are better at recognising trustworthy scenes.

Figure 4

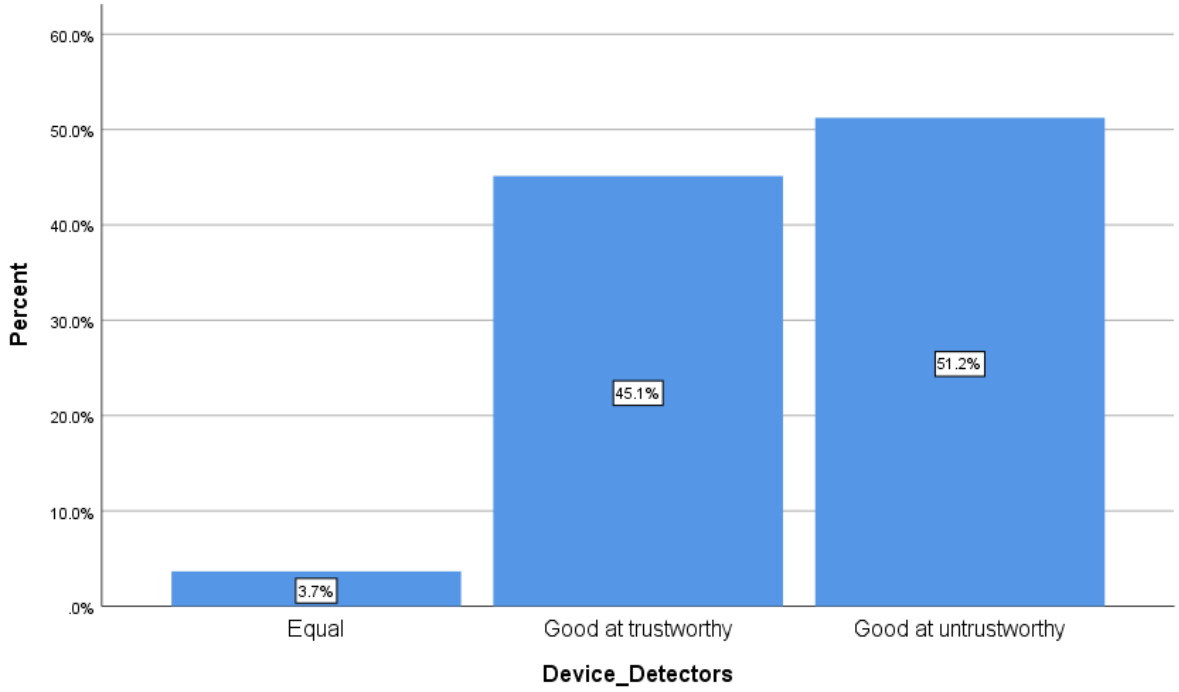
People's distribution in percentages whether they are better at recognising trustworthy or untrustworthy scenes



Regarding devices, there are 3.7% people equally good/sensitive, 51.2% are better at recognising untrustworthy devices, and 45.1% people are better at recognising trustworthy devices (see Figure 5). This shows that people are slightly better at recognising untrustworthy devices than trustworthy devices.

Figure 5

People's distribution in percentages whether they are better at recognising trustworthy or untrustworthy devices



It is visible that there is a difference, when looking at individuals and at specific stimuli, and it is necessary to find out why certain people may be better at recognising either trustworthy or untrustworthy objects. Therefore, a regression analysis with attitude and Deltas, and ANOVA with attitude amongst different stimuli detectors are created. Specifically, the interest is on the effect on people's ability to recognise a trustworthy and untrustworthy. The results show no significant effect by attitude, meaning that attitude towards technology does not affect people ability to recognise a trustworthy and untrustworthy device.

Discussion

The general idea of this study was to explore if memory plays a role in recognition of different trustworthy and untrustworthy stimulus – faces, scenes, devices/technology. In addition, if attitude towards technology affect people's ability to recognise a trustworthy and untrustworthy device. The results of this exploratory investigation showed that there is no difference between the sensitivity towards recognising untrustworthy and trustworthy objects,

however, memory does play a role in recognition of trustworthy and untrustworthy stimulus, because *d'*_pre-test (flags) enables people to discriminate correctly between the objects. Results about the role of attitude towards technology on recognition showed no effect on recognition. Therefore, attitude is non-influential factor towards trustworthy and untrustworthy objects recognition.

The expectation of this study was that people would recognise the untrustworthy objects better, but, in overall, by checking the results of created groups, 44% people were better at recognising untrustworthy objects, whereas 54.8% were better at recognising trustworthy objects. However, by analysing further the results of different stimuli, there were some differences. For example, people were better at recognising untrustworthy faces than trustworthy faces – 55.4% and 43.4%, accordingly. These results about faces, which are descriptive date, seems in line with the ones that were gained in studies by Cosmides (1989), Cosmides and Tooby (1992) and Yamagishi (2003), where it was shown that, generally, people are good at recognising cheaters, even when looking at pictures. However, our analysis did not identify any significant differences.

As this study intended to explore not only faces, these results were compared and assumed that people would recognise better not only untrustworthy faces than trustworthy faces, but also scenes and devices. Regarding scenes, it is shown that scenes that are trustworthy are recognised better.

However, the results for devices indicated the opposite what the overall results and results for scenes were. Descriptive data showed that people were better at recognising untrustworthy devices (51.2%) than recognising trustworthy devices (45.1%), however, the difference between those results are not big. Although the results between groups vary, the results about faces and devices cannot confirm the expectation, as the differences are not significant. Therefore, it cannot be said and related to what was stated in previous studies that

people do have like a cognitive mechanism focused on cheater detection, allowing them to distinguish between cheaters and co-operators better (Cosmides, 1989; Cosmides & Tooby, 1992) due to insignificant difference. It has been only shown that memory play a role in the recognition of trustworthy and untrustworthy stimuli, but people are equally good/sensitive at recognition, however, with some trends towards recognising better different stimuli.

Regardless of the size of the difference, the aim was also to explore what can influence the recognition – why some people may be better at recognising untrustworthy objects better than trustworthy objects. As the information about people's attitude towards technology was gathered through a questionnaire and then analysed, it was checked whether attitude towards technology affect people's ability to recognise a trustworthy and untrustworthy device. The results showed that there is no significant effect on people's recognition between untrustworthy and trustworthy objects and, particularly, devices/technology.

In terms of limitations, there was one major limitation that affected this experiment. During the period of this project, there was a COVID-19 pandemic that affected the experimental process, which lead to smaller sample size than initially was planned. Other limitations were that participants were not performing the experiment at one specific location. In total, four researchers worked on this project, therefore, there were minor changes and perhaps slightly different circumstances for different participants. In addition, due to COVID-19, some participants were performing through a shared screen by a researcher, potentially impairing the outcomes.

Recommendations

Regarding recommendations, first would be to increase the break time between the stages within the experiment. Even though not in every aspect people were better at recognising untrustworthy objects than trustworthy but they were in stimulus with faces and devices. By

doing so, it would be possible to check and analyse more how memory ability is affected by trustworthy and untrustworthy stimulus and to see if different break times can confirm or reject this study's expectation that people would remember more the untrustworthy objects. During this 30-minute break, participants could rely on their memory, because the more time is involved, the less the memory may be involved. Therefore, the less memory is involved, then the higher the potential chances of recognising better untrustworthy objects. Another recommendation would be the sample size. As previously mentioned, due to limitations, sample size was smaller than initially planned. In the end, there were 84 participants, however, the plan was to have around 60 participants per researcher, hence, around 240 participants in total. The bigger the sample, the more accurate the results. As this was an exploratory research and as the human-computer interactions are increasing, it is recommended to study this and similar topics further.

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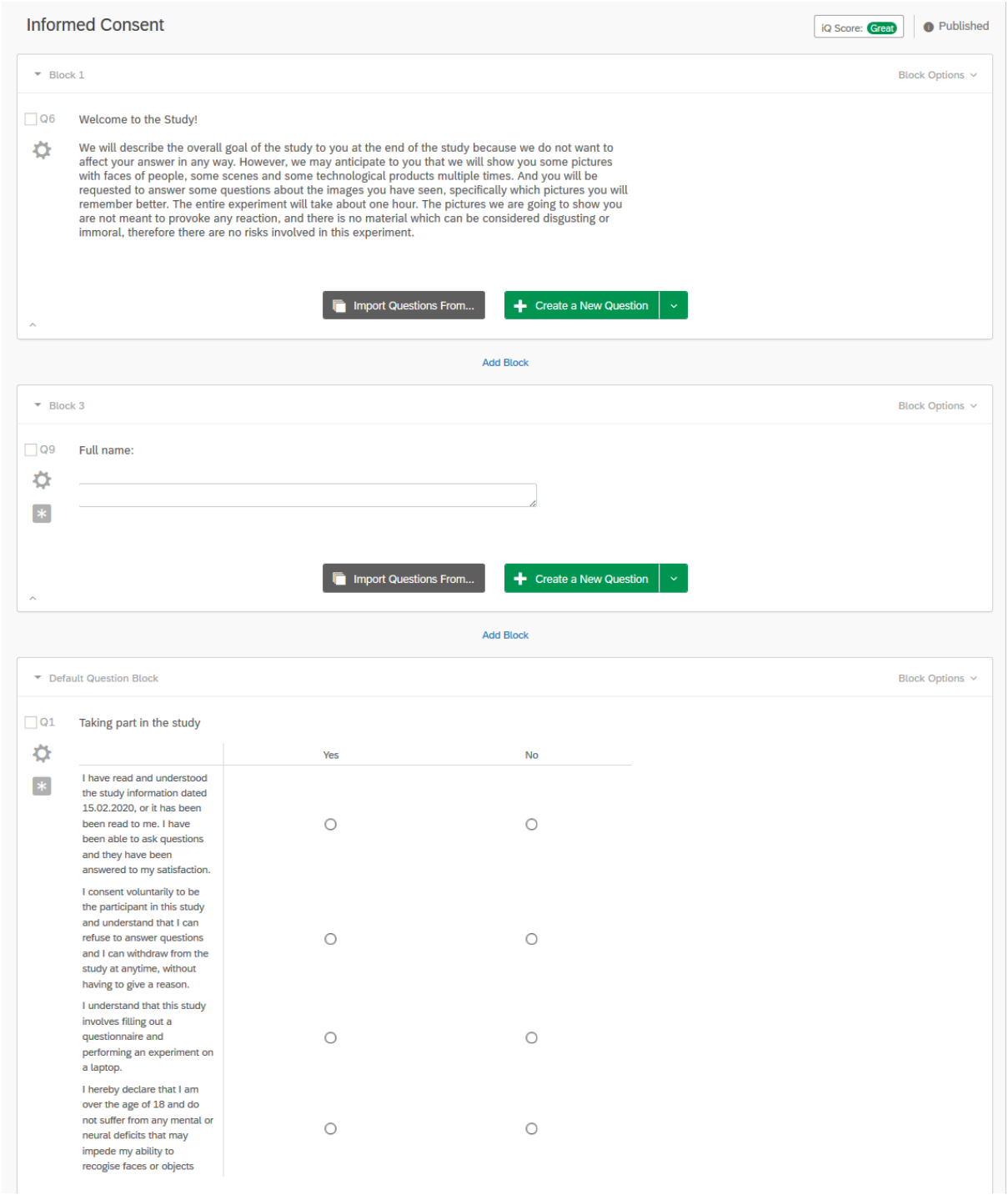
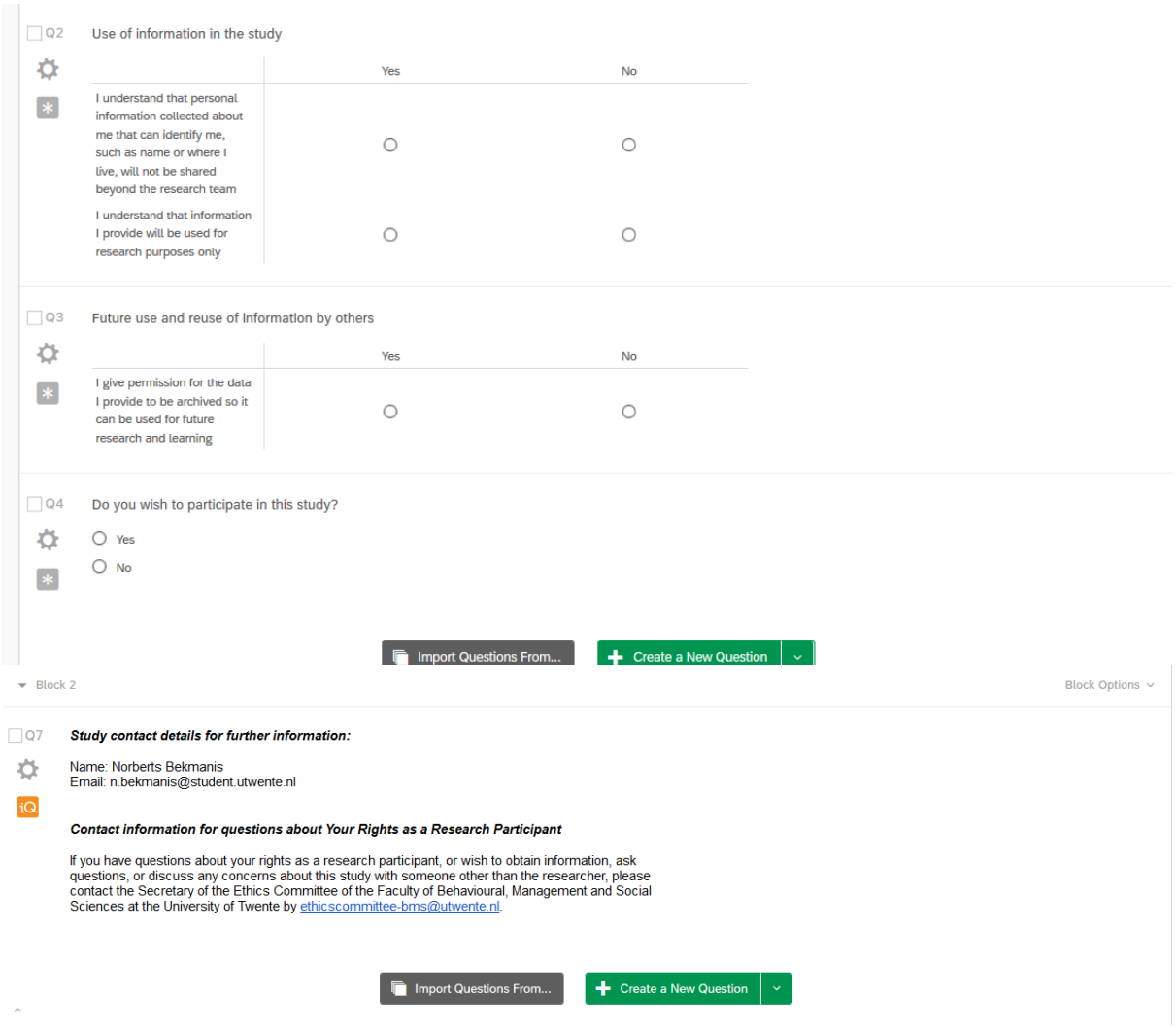
Appendix

Appendix A - Participant Consent Form;

https://utwentebs.eu.qualtrics.com/jfe/form/SV_d4jCPVKP2OkQrtj




Q2
Use of information in the study
Yes
No
I understand that personal information collected about me that can identify me, such as name or where I live, will not be shared beyond the research team
I understand that information I provide will be used for research purposes only
Q3
Future use and reuse of information by others
Yes
No
I give permission for the data I provide to be archived so it can be used for future research and learning
Q4
Do you wish to participate in this study?
Yes
No
Import Questions From...
Create a New Question

Block 2
Block Options
Q7
Study contact details for further information:
Name: Norberts Bekmanis
Email: n.bekmanis@student.utwente.nl
Contact information for questions about Your Rights as a Research Participant
If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher, please contact the Secretary of the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-bms@utwente.nl.
Import Questions From...
Create a New Question

Appendix B – Experimental Design Protocol (Stimuli design)

Extrapolated from two databases a set of 80 images:

- 40 from the CHICAGO FACE DATABASE CFD: Images of people faces rated as trustworthy and untrustworthy
    - 20 images of potential defectors (rated as the less trustworthy)
    - 20 images of potential co-operators (rated as the most trustworthy)
- 40 from the socio-moral data basis SMID: Images of scenes rated as unfair and immoral, or fair and moral.
    - 20 images of untrustworthy scenes (rated as the less fair and moral)
    - 20 images of trustworthy scenes (rated as highly fair and moral)

In addition, a database of 40 trustworthy and untrustworthy products as follows was developed:

- 20 commercial products that were considered untrustworthy for different reasons (e.g. costumer review) were identified
- 20 images of similar types of commercial products that are considered reliable and were never recalled or have exposed people to danger were added.

Chicago Face Database CFD

CFDCODE	Number	
AM-219	1	Untrustworthy
WM-249	2	
LM-226	3	
LM-246	4	
BF-200	5	
BM-219	6	
WF-240	7	
BF-224	8	
LM-203	9	
WM-010	10	
LM-202	11	
WM-220	12	
AM-249	13	
WM-243	14	
WM-235	15	
BM-224	16	
BF-227	17	
WF-210	18	
LF-218	19	
WM-019	20	

BM-043	1	Trustworthy
WF-233	2	
BF-217	3	
BM-236	4	
WF-242	5	
BF-041	6	
AF-218	7	
AF-235	8	
AF-243	9	
BF-218	10	
AM-215	11	
LF-249	12	
BF-212	13	
AF-252	14	
AM-210	15	
AF-244	16	
BM-249	17	
WF-203	18	
LM-201	19	
BF-251	20	

SMID stimuli

SMIDCODE	Number	
b11_p172_20	1	Untrustworthy
b999_p497_3	2	
b999_p486_19	3	
b1_p7_6	4	
b999_p477_19	5	
b14_p271_9	6	
b15_p406_11	7	
b13_p237_19	8	
b10_p136_12	9	
b15_p434_14	10	
b999_p493_11	11	
b4_p72_12	12	
b15_p377_12	13	
b14_p284_12	14	
b10_p140_10	15	
b999_p478_10	16	
b999_p496_18	17	
b13_p223_4	18	
b999_p480_9	19	

b11_p160_18	20	
b10_p132_11	1	Trustworthy
b13_p237_16	2	
b15_p379_8	3	
b13_p223_6	4	
b10_p129_16	5	
b11_p169_16	6	
b15_p307_19	7	
b15_p432_3	8	
b15_p355_10	9	
b15_p420_2	10	
b6_p89_1	11	
b15_p297_2	12	
b10_p134_13	13	
b6_p88_6	14	
b11_p159_3	15	
b15_p401_5	16	
b2_p38_19	17	
b15_p468_15	18	
b8_p112_8	19	
b7_p95_7	20	

Appendix C - Video 1 Tedx The power of vulnerability:

https://www.ted.com/talks/brene_brown_the_power_of_vulnerability?language=en

Appendix D - Questionnaire on demographics, attitude, trust towards technology, and on the Big Five Personality Traits;

https://utwentebs.eu.qualtrics.com/jfe/form/SV_9QTUm2G2wdu82od

Q3 What is your age?

Q5 What is your sex?

- Male
- Female
- Other

Q7 What is your nationality? (e.g. Dutch, English, German etc.)

Q6 What is the highest level of school you have completed or the highest degree you have received?

- Less than high school degree
- High school graduate (high school diploma or equivalent including GED)
- Some college but no degree
- Associate degree in college (2-year)
- Bachelor's degree in college (4-year)
- Master's degree
- Doctoral degree
- Professional degree (JD, MD)

Q6 What is your occupation/ What do you study?

Attitudes towards technology/ Dependency on technology

Q11 **Indicate for each statement whether it is** 1. Strongly Disagree, 2. Disagree, 3. Neither Agree Nor Disagree, 4. Agree, or 5. Strongly Agree.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I feel it is important to be able to find any information whenever I want online	○	○	○	○	○
I feel it is important to be able to access the Internet any time I want	○	○	○	○	○
I think it is important to keep up with the latest trends in technology	○	○	○	○	○
I get anxious when I don't have my cell phone	○	○	○	○	○
I get anxious when I don't have the Internet available to me	○	○	○	○	○
I am dependent on my technology	○	○	○	○	○
Technology will provide solutions to many of our problems	○	○	○	○	○
With technology anything is possible	○	○	○	○	○
I feel that I get more accomplished because of technology	○	○	○	○	○
New technology makes people waste too much time	○	○	○	○	○
New technology makes life more complicated	○	○	○	○	○
New technology makes people more isolated	○	○	○	○	○

Trust in Technology

Q16

Indicate for each statement whether it is 1. Strongly Disagree, 2. Disagree, 3. Neither Agree Nor Disagree, 4. Agree, or 5. Strongly Agree.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I believe that most technologies are effective at what they are designed to do	○	○	○	○	○
A large majority of technologies are excellent	○	○	○	○	○
Most technologies have the features needed for their domain	○	○	○	○	○
I think most technologies enable me to do what I need to do	○	○	○	○	○
My typical approach is to trust new technologies until they prove to me that I shouldn't trust them	○	○	○	○	○
I usually trust a technology until it gives me a reason not to trust it	○	○	○	○	○
I generally give a technology the benefit of the doubt when I first use it	○	○	○	○	○

Big 5 Personality Traits

Q15

Instructions: Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age.
Indicate for each statement whether it is 1. Very Inaccurate, 2. Moderately Inaccurate, 3. Neither Accurate Nor Inaccurate, 4. Moderately Accurate, or 5. Very Accurate as a description of you.

	Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
Am the life of the party	○	○	○	○	○
Feel little concern for others	○	○	○	○	○
Am always prepared	○	○	○	○	○
Get stressed out easily	○	○	○	○	○
Have a rich vocabulary	○	○	○	○	○
Don't talk a lot	○	○	○	○	○
Am interested in people	○	○	○	○	○
Leave my belongings around	○	○	○	○	○
Am relaxed most of the time	○	○	○	○	○
Have difficulty understanding abstract ideas	○	○	○	○	○
Feel comfortable around people	○	○	○	○	○
Insult people	○	○	○	○	○
Pay attention to details	○	○	○	○	○
Worry about things	○	○	○	○	○
Have a vivid imagination	○	○	○	○	○
Keep in the background	○	○	○	○	○
Sympathize with others' feelings	○	○	○	○	○
Make a mess of things	○	○	○	○	○
Seldom feel blue	○	○	○	○	○
Am not interested in abstract ideas	○	○	○	○	○

Start conversations	○	○	○	○	○
Am not interested in other people's problems	○	○	○	○	○
Get chores done right away	○	○	○	○	○
Am easily disturbed	○	○	○	○	○
Have excellent ideas	○	○	○	○	○
Have little to say	○	○	○	○	○
Have a soft heart	○	○	○	○	○
Often forget to put things back in their proper place	○	○	○	○	○
Get upset easily	○	○	○	○	○
Do not have a good imagination	○	○	○	○	○
Talk to a lot of different people at parties	○	○	○	○	○
Am not really interested in others	○	○	○	○	○
Like order	○	○	○	○	○
Change my mood a lot	○	○	○	○	○
Am quick to understand things	○	○	○	○	○
Don't like to draw attention to myself	○	○	○	○	○
Take time out for others	○	○	○	○	○
Shirk my duties	○	○	○	○	○
Have frequent mood swings	○	○	○	○	○
Use difficult words	○	○	○	○	○
Don't mind being the center of attention	○	○	○	○	○
Feel others' emotions	○	○	○	○	○
Follow a schedule	○	○	○	○	○
Get irritated easily	○	○	○	○	○
Spend time reflecting on things	○	○	○	○	○
Am quiet around strangers	○	○	○	○	○
Make people feel at ease	○	○	○	○	○
Am exacting in my work	○	○	○	○	○
Often feel blue	○	○	○	○	○
Am full of ideas	○	○	○	○	○