

## Colors and Trust: The Influence of User Interface Design on Trust and Reciprocity

Florian Hawlitschek  
Karlsruhe Institute of Technology  
[florian.hawlitschek@kit.edu](mailto:florian.hawlitschek@kit.edu)

Lars-Erik Jansen  
Karlsruhe Institute of Technology  
[larserikjansen14@gmail.com](mailto:larserikjansen14@gmail.com)

Ewa Lux  
Karlsruhe Institute of Technology  
[ewa.lux@kit.edu](mailto:ewa.lux@kit.edu)

Timm Teubner  
Karlsruhe Institute of Technology  
[timmm.teubner@kit.edu](mailto:timmm.teubner@kit.edu)

Christof Weinhardt  
Karlsruhe Institute of Technology  
[weinhardt@kit.edu](mailto:weinhardt@kit.edu)

### Abstract

*Interpersonal trust and reciprocation are crucial factors in peer-to-peer online interactions. In order to shed more light on the association of user interface (UI) design and trusting as well as reciprocating behavior, we consider a computerized trust game with different interface background colors, red and blue, namely. We locate our work within recent NeuroIS theory, linking UI background color to user behavior via perceived warmth of UIs and color appeal. The results of a laboratory experiment indicate an enhancing effect of red interfaces on reciprocation behavior, fully mediated by perceived warmth. We suggest to further investigate this phenomenon by applying NeuroIS methodology.*

### 1. Introduction

Colors have powerful impacts on our lives. They influence our mood and emotions but also our task performance, e.g. in decision making [2, 3, 24, 29, 42, 51, 58, 60, 66]. Consequently, conscious use of colors for the design of information systems (IS) and especially online market platforms is of utmost importance [22]. It is argued that colors not only influence our attitude and expectations toward brands but are also associated with certain differences in trusting behavior towards websites [22].

Especially on peer-to-peer e-commerce platforms, trusting and reciprocating behavior between users is key [10]. Most interactions in the context of the so called “Sharing Economy,” (such as peer-to-peer rental of cars and apartments or market-based redistribution of used products) require a certain level of interpersonal trust between provider and consumer, e.g. regarding overuse or abuse of the shared product [44] or simple shipping decisions [10], and thus also rely on

reciprocal benevolent behavior (see [41]). Little is known about the impacts of colors on human behavior in peer-to-peer market environments with monetary stakes—particularly regarding trust and reciprocity.

Our research is based on two strands of the literature. Firstly, recent NeuroIS experiments have suggested an effect of temperature priming on both, interpersonal warmth and trusting behavior [38, 43, 59, 63, 68]. Researchers found that warmer environmental conditions induce greater social proximity and conclude that environmentally induced conditions shape construal of social relationships [36]. Furthermore, Kang et al. [38] observed physical temperature to have an influence on trust behavior and identified, consistent with previous work [15, 23, 47], the insula as a possible neural substrate. Secondly, literature on colors in IS research, consumer behavior, and other fields suggests that colors such as blue (red) are commonly perceived as cool (warm) [8, 9, 48]. In a recent empirical study on that phenomenon, Fenko et al. [30] showed that the perceived warmth of products was significantly increased if they had a red in comparison to a blue color. We draw from both strands by investigating the influence of cool (blue) and warm (red) colors on trusting and reciprocating behavior in a simple economic experiment focusing on such behaviors—commonly known as the trust game [7].

To the best of our knowledge, the influence of colors on trusting and reciprocating behavior has not been investigated in a comparable setting with monetary stakes so far. The trust game is a well-established approach to analyze such behavior [7]. In a first attempt, we investigate the influence of a red and a blue UI on temperature perception and behavior of participants. Specifically, we aim to shed more light on the following research question:

**RQ:** How does a cool color like blue and a warm color like red influence trusting and reciprocating behavior in computerized trust situations?

In the following we introduce a literature-based research model and give a brief overview on color-related research in IS. We subsequently describe our experimental design and present results and insights from a pilot study. Finally, we discuss the potential impact of our research on IS design as well as the limitations of the work at hand.

## 2. Related literature and research model

Colors can induce a certain perception of warmth (see [30], for instance). It furthermore has been suggested that cold and warm temperatures, driven by the role of the insula, influence interpersonal warmth and trusting behavior (e.g., [63] and [38]). We argue that such effects are also observable for cool and warm colors such as blue and red.

As a theoretical basis for our research model (depicted in Figure 2) we present an overview of related literature. Firstly, we review research related to the trust game from a NeuroIS perspective. Secondly, we summarize different studies on colors and temperature perception. Thirdly, we present a brief overview on the role of colors in IS research. We finally condense our argumentation in five research hypotheses.

### 2.1. A NeuroIS view on the trust game

Trust in Internet transactions has experienced a lot of attention in IS research. In 1995, the trust game was introduced by Berg et al. [7] as a means of analyzing interpersonal trust and reciprocity. Since then it was applied, further developed, and cited in several thousand studies.

According to the original game's mechanics (see Figure 1), two subjects (the "trustor" and the "trustee") interact in a two-stage investment setting. In the first stage of the game the trustor must decide on how much of an endowment of 10 monetary units (MU) she wants to transfer to the anonymous trustee (a 10\$ show-up

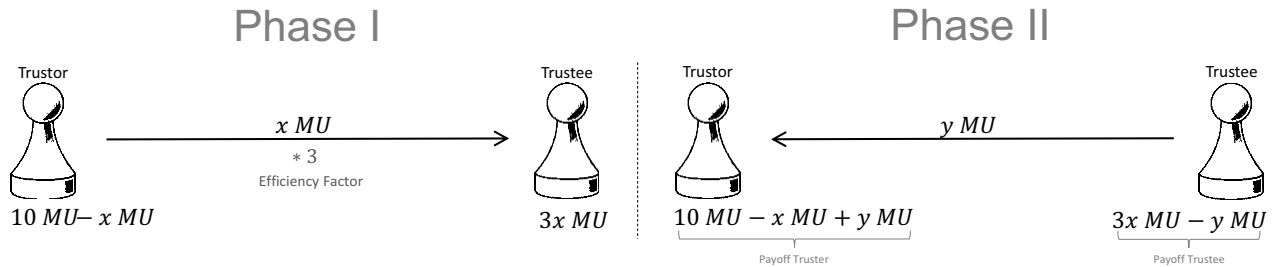
fee was provided in the original experiment). The transferred amount is tripled. In the second stage, the trustee decides on how much of the received (and tripled) amount to return. The respective amounts invested and returned are considered indicators for trust and reciprocation.

A recent neuroscientific study focused on how temperature priming influences behavior in a trust game [38]. Participants touched either a cold or a warm temperate pad prior to the experiment. The packs were cooled down to 15°C or heated up to 41°C. Participants who held a cold pack before playing the trust game transferred less money in the first stage than those who touched the warm pack. During the trust game neural activity was measured by functional magnetic resonance imaging (fMRI). It could be shown that the left-anterior insular cortex was more active during trust decisions and betrayals of trust but only after touching the cold pack and not the warm [38]. The insula is considered as a brain region that translates visceral sensation into emotions [14, 16, 17]. It is especially associated with aversive sensory inputs transformed into negative affective states [62]. Kang et al. [38] concluded that cold temperature priming activates the insula, which eventually influences interpersonal relationships, reducing trust behavior. This conclusion is supported by Dimoka [25], who showed that distrust is associated with activation of the insular cortex.

Based on the work of Kang et al. [38], the influence of thermal manipulation on trust decisions, cooperation and therefore trustworthiness in a game of iterated Prisoner's Dilemmas was measured by Storey and Workman [59]. The authors' results indicated that participants primed with hot objects cooperated significantly more frequently than those primed with cold objects.

According to Bargh and Shalev [4] and Cuddy et al. [18], a "warm" character is viewed as good-natured, trustworthy, tolerant, friendly, and sincere. "Cold" individuals are considered to be self-centered, competitive, and untrustworthy.

In a study by Williams and Bargh [63], participants



**Figure 1. Mechanics of the trust game.**

Phases I and II in the trust game [7], including decisions ( $x$ ,  $y$ ) and payoff formula for trustor and trustee based on a 10 monetary unit endowment for the trustor.

were primed with physical coldness (warmth), which resulted in decreased (increased) interpersonal warmth. Participants primed with cold (warm) temperature chose in 75% (54%) of the cases a gift for themselves and in 25% (46%) a gift for a friend. Although these results were not retrieved in a replication study by Lynott et al. [46], the literature supports the idea of links between temperature and behavior in general. IJzerman and Semin [36], for instance, conducted three experiments which indicated that warmer environmental conditions induce greater social proximity, more concrete language, and a greater relational focus of participants than colder conditions. Bargh and Shalev [4] suggested that people try to regulate their feelings of social affiliation with applications of physical warmth. They observed that people with a high score of loneliness tended to take not only longer but also warmer baths and showers. In an experimental setting the authors also manipulated physical temperature by giving the participants objects of different temperatures. It was found that cold objects increased the feeling of loneliness significantly. When participants had to read socially warm and neutral messages from friends and family while holding a warm and neutral temperature object, analog results were found [4].

## 2.2. Colors and temperature perception

There is a general understanding across several fields that blue is perceived as a cool, whereas red is perceived as a warm color [8, 9, 48]. In addition to the study of Fenko et al. [30], the following studies indicate significant differences in the perception of temperature influenced by blue and red color or light, in different contexts.

In a recent study, Winzen et al. [64] tested the influence of colored light in an aircraft cabin on passengers' thermal comfort. Their findings indicate that yellow lights generate a perception of warmer while blue lights induces a perception of cooler temperatures.

Effects of color and sound on the perception of warmth were experimentally addressed by Matsubara et al. [49]. As color stimuli, orange and light blue were used. The results revealed that in the presence of orange color people felt warmer at low temperature and in the presence of light blue color felt cooler at high temperature.

Michael and Rolhion [52] could show that the color of a water bottle influenced the thermal sensation in the context of a laboratory experiment. The results indicated that a bottle filled with green water induced a cooling and the red colored liquid induced a warming sensation [52].

Another experiment, testing the effect of different coffee cup colors on the perception of the containing beverage temperature, was conducted by Guéguen and Jacob [35]. The coffee cups had the colors blue, green, yellow, and red and each cup was filled with 40°C hot coffee. Each participant had to drink from each cup. Afterwards they had to indicate the warmest beverage. The red coffee cup was selected as the cup containing the hottest beverage [35].

## 2.3. Colors in IS research

Online vendors depend on their Internet presence to attract potential customers [31]. Specifically, three dimensions of web design are considered relevant for trust. These are (i) visual design, (ii) social cue design, and (iii) content design [39]. According to Cyr [19] and Cyr et al. [20], visual design elements include symbols, use of animation, and color.

Across cultures, color appeal is a significant cause for satisfaction and trust [22]. In a laboratory experiment it could be shown that a higher level of trust in the website resulted in greater levels of e-loyalty [19].

An early experimental study by Kim and Moon [40] indicated that colors might influence the perceived trustworthiness of websites in cyber-banking environments. The authors suggested that the website's color layout should be rather cool than warm in the context of cyber banking. The main color should be in a moderate pastel hue and of low brightness instead of high laminated colors. According to the authors' findings, a feeling of untrustworthiness was related to bright background colors and asymmetrical color schemes.

However, favored colors with regard to a pleasant and happy atmosphere of a website should be bright and lively [65]. Layout design and atmosphere can have a positive impact on consumers' attitudes towards the website, which in turn impacts purchase intentions. Furthermore, the atmosphere impacts emotional arousal of online shoppers which is also positively related to the attitude towards the website and purchase intention [65].

## 2.4. Hypothesis development

Human beings tend to associate different colors with different degrees of warmth. This phenomenon was already investigated in several contexts reaching from studies on personality traits [9] over room temperature [8] to appraisal of office environments [48]. Most studies agree on the notion that blue is perceived as a cool, while red is perceived as a warm

color. In a more recent study Fenko et al. [30] found that subjects' judgment of warmth in products (scarves and breakfast trays) was significantly different for cool (blue) and warm (red) colors. We therefore hypothesize that blue and red UI background colors should also result in different levels of perceived warmth within UIs (see Figure 2 for illustration).

**Hypothesis 1.** For the trustor/trustee, red (compared to blue) color has a positive influence on perceived warmth of the UI (H1a+/H1b+).

A recent neurophysiological study on interpersonal warmth suggested that—driven by the role of the insula in processing both physical temperature and interpersonal warmth—physical temperature priming affects trust behavior [63]. The effect of temperature priming with hot and cold therapeutic packs on interpersonal warmth and trust behavior was also shown in iterated Prisoner's Dilemma [59] and trust game situations [38]. We argue that the color-related perceived warmth of the UI has an analogous effect on interpersonal warmth and trust behavior.

**Hypothesis 2.** For the trustor, perceived warmth of the UI has a positive influence on trusting behavior, i.e., investment (H2+).

In many cases our rational decision making is influenced by certain biases. Especially in the formation of initial trust, we often rely on different types of cues, such as facial characteristics [57], absence or presence of small grammatical and typological errors [13], or gaze cues [5]. The influence of different colors on trust towards an e-commerce website has already been addressed in a multicultural study [21]. The authors found that in their experimental setting, color appeal had a significant influence on the perceived trustworthiness of an e-commerce website. We hence expect that the color appeal increases subjects' trust behavior in the trust game.

**Hypothesis 3.** For the trustor, increased color appeal has a positive influence on trusting behavior, i.e., her investment (H3+).

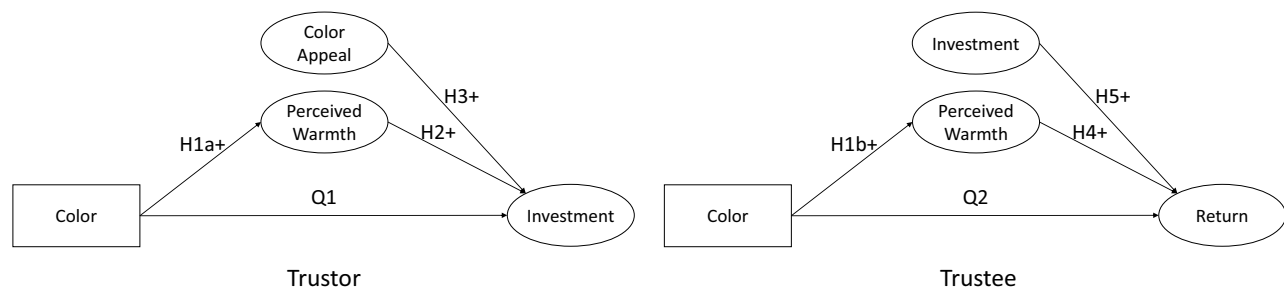
The argumentation leading to hypothesis H2+ also suggests that there should be an effect of perceived warmth of the UI on interpersonal warmth in form of reciprocating behavior. This is in line with the findings of Storey and Workman [59] on cooperation in iterated Prisoner's Dilemma situations.

**Hypothesis 4.** For the trustee, perceived warmth of the UI has a positive influence on reciprocating behavior, i.e., return (H4+).

Not only does the investment of trustors signal positive intentions in a trust game and therefore promotes a trust and reciprocity relationship [50], it also forms a leeway for higher returns that are enabled by the multiplication factor. Based on this and well-known results from trust game experiments (e.g. [7] and [50]), we suggest the following:

**Hypothesis 5.** For the trustee, the trustor's investment has a positive influence on reciprocating behavior, i.e., return (H5+).

Depending on the cultural background of a person, direct effects of different color schemes on trust towards an e-commerce website could be observed in experiments [22]. Also a neurophysiological study related to colors suggests a certain role of the insula for the perception of colors [11]. Therefore we suggest that in line with the observations of Kang et al. [38], there exist direct effects of color on interpersonal warmth and trust behavior. Since this influence of UI color could also be mediated by perceived temperature, the effects of red (compared to blue) color on trusting behavior and reciprocation are kept as open questions (Q1 and Q2), with no hypothesized direction.



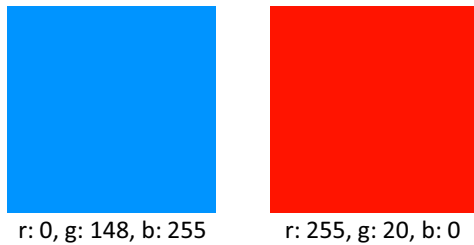
**Figure 2. Research models for trustor and trustee.**

Hypothesized influences of blue or red color from trustor and trustee perspective. The direct effects of color on investment and return are investigated as open questions for the time being.

### 3. Experimental evaluation

In order to test our hypotheses, we conducted a computerized trust game experiment in a controlled laboratory environment. Two participants at a time were matched as a pair and interacted in the trust game situation. Participants were recruited using the Online Recruitment System for Economic Experiments (ORSEE) [34] for the participant pool at the Karlsruhe Institute for Technology. In total 8 sessions were conducted in March 2015. The study hence comprised a total of 92 participants (65 male, 27 female, average age = 22.9 years, and ~58% with economic background).

Each participant was randomly assigned to either a blue or a red color treatment (see Figure 3) and within this treatment group to one of the two possible roles (trustor or trustee). We applied a complete between-subject design, i.e., each participant only encountered one treatment condition and role. Moreover, the interaction was one-shot, i.e., each participant played the trust game only once, avoiding learning and order effects. Consequently, we realized 23 observations per color-role-combination.



**Figure 3. User interface colors.**

User interface colors used for blue and red color treatments, including RGB values.

The experiment was implemented using the software environment BROWNIE [53], a NeuroIS platform for lab experiments. UIs for all participants were displayed on IBM ThinkVision T860 9494-HB0 18" LCD 9494-HB0 computer screens with the following settings: brightness: 100, contrast: 100, color: r 50, g 50, b 50. Furthermore, both room temperature and lighting were kept constant using roller shutters, artificial light and air conditioning (~22°C and ~40% humidity).

Each session was structured as follows: Firstly, after arriving at the lab, participants were welcomed and randomly seated on separate computer terminals. No visual contact or other communication between participants was possible. All participants then listened to the recorded instructions as a group. Afterwards they were exposed to a 10 seconds color priming by

watching an empty screen in either red or blue color, according to their assigned treatment. Subsequently, all participants played a one-shot trust game in the same UI background color following the design of Berg et al. [7]. The trustor received an endowment of 10 monetary units (10 MU = 2.50 EUR ≈ 2.82 US\$) and had to decide how much of her endowment to transfer to a randomly assigned trustee in her session. Each unit transferred was multiplied with an efficiency factor  $\delta=3$  and afterwards credited to the trustee. In the next step, the trustee had to decide how many of the received monetary units to transfer back to the trustor.

After this one-shot interaction, participants filled out a questionnaire covering the two adapted constructs *color appeal* [22] and *perceived warmth* [30] (see Table 1), as well as questions regarding their demographic background and general remarks. Finally and one by one, participants received their individual payoff in a separate room. Each experimental session had an approximate length of 15 minutes.

Construct	Item	Source
<i>perceived warmth</i> (PW)	PW1: How warm did you find the color of the screen?	adapted from [30]
<i>color appeal</i> (CA)	CA1: The color on the screen was pleasing.	adapted from [22]
	CA2: I liked the color on the screen.	
	CA3: The color on the screen was appropriate for my culture.	
	CA4: The color on the screen was emotionally appealing.	
	CA5: The color on the screen was interesting.	

**Table 1. Constructs.**

Adapted constructs *perceived warmth* and *color appeal*, including items and sources.

The 1-item construct *perceived warmth* (adapted from [30]) was measured on a 1-7 Likert scale (1 = very cold, 7 = very warm). For the adapted 5-items construct *color appeal* [22], which was also measured on a 1-7 Likert scale (1 = strongly disagree, 7 = strongly agree) construct reliability and construct validity were tested. Construct reliability was examined using Cronbach's alpha. The construct had a Cronbach's alpha of 0.7, and thus did not exceed the threshold suggested by Nunnally and Bernstein [54]. Convergent validity was tested by examining Average Variance Extracted (AVE). The AVE did not exceeded 0.5 [1] but scored at 0.3. Consequently, the construct should be revised for future work.

## 4. Results

In this paper we focus on the two main behavioral variables *investment* and *return* (i.e., the amount of monetary units transferred from the trustor to the trustee and vice versa) as laid out in the experimental design section.

The proposed research model was validated using Structural Equation Modelling (SEM). Specifically, the software smartPLS was used due to its flexibility in terms of sample size, data and residuals distribution [56, 12]. The sample size of this study ( $n_{\text{trustee}} = 46$ ,  $n_{\text{trustor}} = 46$ ) exceeded the minimum number required to validate a model in PLS. Following the rule of Gefen et al. [32] it should exceed (i) the number of path coefficients of every single dependent variable by a factor of 10, and (ii) the number of items of the most complex construct (i.e., a minimum of 30 participants).

The results of the PLS analysis are presented in Figure 4. Following Chin [12], bootstrapping with 500 subsamples was performed to test the statistical significance of the path coefficients (t-tests).

For the trustors' initial decision of how much to transfer to the trustee as an investment, none of the hypothesized factors (*perceived warmth* (H2+), *color appeal* (H3+) and also *color<sup>(Red)</sup>* (Q1)) had a significant impact. Subjects in the red color condition, however, perceived the experimental interface as warmer than subjects in the blue color condition (H1a+/H1b+). Turning to the trustee, i.e., the second mover in the experiment, we find that her return is affected by *color*, where this effect is fully carried by *perceived warmth* (H4+) (see Figure 4). In order to control for the fact that different investment values enable different ranges of returns, we use the preceding investment as a control variable. We find a positive relation between *investment* and *return* (H5+). However, no significant direct effect of *color<sup>(Red)</sup>* (Q2) is observable.

Recent IS literature has started to consider

significance levels between .05 and .10 as “marginal” significance [28]. Considering this and the relatively small sample size of our study, we find that (i) both trustees and trustors perceive red interfaces as warmer than blue ones, (ii) investment behavior is not affected by color whatsoever, and (iii) there is an enhancing effect of red (compared to blue) interfaces on return behavior, fully mediated by *perceived warmth*.

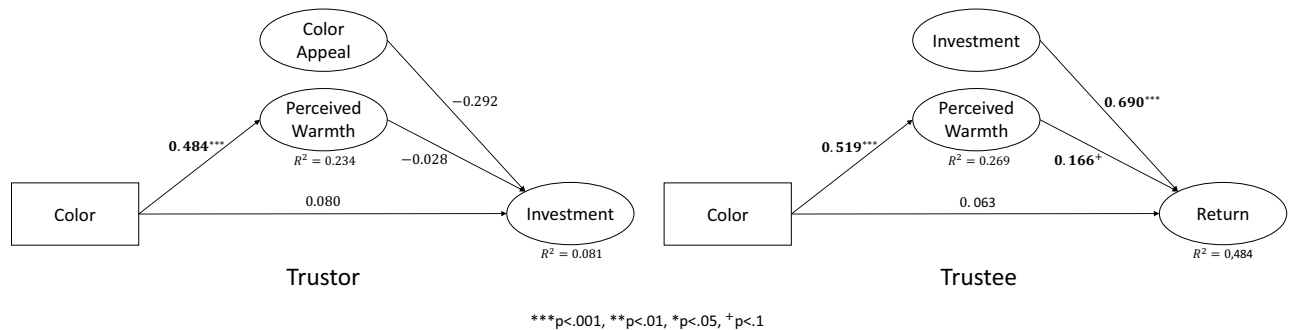
## 5. Conclusion and discussion

Within the scope of this article, we introduce a literature-based research model for the role of blue and red UI color on behavior in a trust game. Furthermore, we provide insights from a laboratory pilot study with 92 subjects, indicating that participants perceived increased warmth of their UI when confronted with red instead of blue background color. With respect to the participants' behavior, we find a marginally significant effect of perceived warmth resulting from the background color of the screen and also from color appeal on returns (i.e., reciprocating behavior) by the trustee. However, we find no such effects on the trustor's investment (i.e., trusting behavior).

Bearing in mind that the experiment was carried out as a one-shot interaction with an initial trustor endowment of 2.50 EUR ( $\approx 2.82$  US\$), we argue that the distribution of investments might have been effected by the willingness to take higher risks due to low monetary stakes [37], as also indicated by participants in written comments. This might have promoted an increased overall level of investment, hiding the effects of color on trust.

Following the same line of reasoning, both questions Q1 and Q2 remain unanswered for the time being and will need to be addressed in future research.

Trust as well as reciprocity are psychological constructs, not only highly relevant for participant interaction in the current research, but also affecting



**Figure 4. Results of the PLS analysis.**

Results for the PLS analysis of trustor and trustee model. Bootstrapping with 500 subsamples was performed to test the statistical significance of the path coefficients (t-tests).

consumer behavior on electronic markets in general and on peer-to-peer platforms in particular [6, 33]. The conscious use of colors in UI design for such environments (e.g. regarding colored advertising banners as depicted in Figure A1 in the Appendix) might help to positively influence user interaction, as indicated by our study.

To gain deeper insights in (i) what causes trust and reciprocal behavior, (ii) how these constructs could be manipulated, and (iii) what their effects on human interaction and IS are, further knowledge about users' cognitive, emotional, and physiological state is required [25, 26, 27]. For investigation of such user states, neuroscience methodology is already applied in similar research, e.g. [45, 55, 61], to better understand the design, development and use of information systems, but also to derive new theories that predict user behavior and impact IS related constructs, such as trust and reciprocity [45].

Based on the presented literature review and the results from our pilot study, we propose the application of NeuroIS methodology and tools, to further investigate the effects of color priming. As suggested in recent literature [38], temperature priming appears to have an effect on the activation of the insular cortex and trust behavior, which again is associated with the insular cortex. Hence, for future research we suggest to further examine the effects of color priming, specifically its effects on the activation of the insular cortex using NeuroIS tools such as fMRI.

## 6. Limitations

Whether or not our results can be generalized for a broader spectrum of users and cultures is an open question and a limitation, since the participants in our study were university students from Karlsruhe, predominantly grown up in Germany, who were placed in an experimental environment. Furthermore, due to the pilot character of the study, our results are only based on a comparably small number of observations. Another limitation is based on the applied incentive structure which might have encouraged overly risky decisions and therefore lead to unexpectedly high investments. An introduction of higher monetary stakes may yield different outcomes. In addition to that, the small  $R^2$  (for investment) indicates that additional explanatory factors should be considered in future investigations. Finally, we have not yet shown the role of the insula in the context of color treatments in the trust game. Therefore we consider our work as a call for further investigating the impact of colors on trusting and reciprocating behavior based on NeuroIS methodology.

## References

- [1] N. Au, E. Ngai, and T. C. Cheng, "Extending the understanding of end user information systems satisfaction formation: An equitable needs fulfillment model approach", *MIS Quarterly*, 32(1), 2008, pp. 43–66.
- [2] B. J. Babin, D. M. Hardesty, and T. A. Suter, "Color and shopping intentions: The intervening effect of price fairness and perceived affect", *Journal of Business Research*, 56(7), 2003, pp. 541–551.
- [3] R. Bagchi and A. Cheema, "The effect of red background color on willingness-to-pay: The moderating role of selling mechanism", *Journal of Consumer Research*, 39(5), 2013, pp. 947–960.
- [4] J. A. Bargh and I. Shalev, "The substitutability of physical and social warmth in daily life", *Emotion*, 12(1), 2012, pp. 154–162.
- [5] A. P. Bayliss and S. P. Tipper, "Predictive gaze cues and personality judgments should eye trust you?", *Psychological Science*, 17(6), 2006, pp. 514–520.
- [6] I. Benbasat, D. Gefen, and P.A. Pavlou, "Special issue: Trust in online environments", *Journal of Management Information Systems*, 24(4), 2008, pp. 5–11.
- [7] J. Berg, J. Dickhaut, and K. McCabe, "Trust, reciprocity, and social history", *Games and Economic Behavior*, 10(1), 1995, pp. 122–142.
- [8] P. C. Berry, "Effect of colored illumination upon perceived temperature", *Journal of Applied Psychology*, 45(4), 1961, pp. 248–250.
- [9] A. Bjerstedt, "Warm-cool color preferences as potential personality indicators: preliminary note", *Perceptual and Motor Skills*, 10(1), 1960, pp. 31–34.
- [10] G. E. Bolton, E. Katok, and A. Ockenfels, "How effective are electronic reputation mechanisms? An experimental investigation", *Management Science*, 50(11), 2004, pp. 1587–1602.
- [11] C. Cavina-Pratesi, R. W. Kentridge, C. A. Heywood, and A. D. Milner, "Separate channels for processing form, texture, and color: evidence from fMRI adaptation and visual object agnosia", *Cerebral Cortex*, 20(10), 2010, pp. 2319–2332.
- [12] W. W. Chin, "The partial least squares approach for structural equation modeling", *Modern Methods for Business Research*, London: Lawrence Erlbaum Associates, 1998, pp. 295–336.
- [13] C. L. Corritore, B. Kracher, and S. Wiedenbeck, "Online trust: concepts, evolving themes, a model", *International Journal of Human-Computer Studies*, 58(6), 2003, pp. 737–758.

- [14] A. D. Craig, "How do you feel? Interoception: the sense of the physiological condition of the body", *Nature Reviews Neuroscience*, 3(8), 2002, pp. 655–666.
- [15] A. D. Craig, K. Chen, D. Bandy, and E. M. Reiman, "Thermosensory activation of insular cortex", *Nature Neuroscience*, 3(2), 2000, pp. 184–190.
- [16] H. D. Critchley, C.J. Mathias, and R.J. Dolan, "Fear conditioning in humans: the influence of awareness and autonomic arousal on functional neuroanatomy", *Neuron*, 33(4), 2002, pp. 653–663.
- [17] H. D. Critchley, S. Wiens, P. Rotshtein, A. Ohman, and R.J. Dolan, "Neural systems supporting interoceptive awareness", *Natural Neuroscience*, 7(2), 2004, pp. 189–195.
- [18] A. J. Cuddy, S. T. Fiske, and P. Glick, "Warmth and competence as universal dimensions of social perception: The stereotype content model and the BIAS map", *Advances in Experimental Social Psychology*, 40, 2008, pp. 61–149.
- [19] D. Cyr, "Modeling web site design across cultures: relationships to trust, satisfaction, and e-loyalty.", *Journal of Management Information Systems*, 24(4), 2008, pp. 47–72.
- [20] D. Cyr, G. S. Kindra, and S. Dash, "Web site design, trust, satisfaction and e-loyalty: the Indian experience", *Online Information Review*, 32(6), 2008, pp. 773–790.
- [21] D. Cyr, M. Head, H. Larios, and B. Pan, "Exploring human images in website design: a multi-method approach", *MIS Quarterly*, 33(3), 2009, pp. 539–566.
- [22] D. Cyr, M. Head, and H. Larios, "Colour appeal in website design within and across cultures: A multi-method evaluation", *International Journal of Human-Computer Studies*, 68(1), 2010, pp. 1–21.
- [23] K. D. Davis, C. L. Kwan, A. P. Crawley, and D. J. Mikulis, "Functional MRI study of thalamic and cortical activations evoked by cutaneous heat, cold, and tactile stimuli", *Journal of Neurophysiology*, 80(3), 1998, pp. 1533–1546.
- [24] T. De Bock, M. Pandelaere, and P. Van Kenhove, "When colors backfire: The impact of color cues on moral judgment", *Journal of Consumer Psychology*, 23(3), 2013, pp. 341–348.
- [25] A. Dimoka, "What does the brain tell us about trust and distrust? Evidence from a functional neuroimaging study" *MIS Quarterly*, 34(2), 2010, pp. 373–396.
- [26] A. Dimoka, R. D. Banker, I. Benbasat, F. D. Davis, A. R. Dennis, D. Gefen, A. Gupta, A. Ischebeck, P. Kenning, P. A. Pavlou, G. Müller-Putz, R. Riedl, J. Vom Brocke, and B. Weber, "On the use of neurophysiological tools in IS research: developing a research agenda for NeuroIS", *MIS Quarterly*, 36(3), 2010, pp. 679–702.
- [27] A. Dimoka, P. A. Pavlou, and F. D. Davis, "Research commentary-NeuroIS: the potential of cognitive neuroscience for information systems research", *Information Systems Research*, 22(4), 2011, pp. 687–702.
- [28] A. Dimoka, Y. Hong, and P. A. Pavlou, "On product uncertainty in online markets: Theory and evidence." *MIS Quarterly*, 36(2), 2012, pp.395–426.
- [29] A. J. Elliot, M. A. Maier, A. C. Moller, R. Friedman, and J. Meinhardt, "Color and psychological functioning: the effect of red on performance attainment", *Journal of experimental psychology: General*, 136(1), 2007, pp. 154–168.
- [30] A. Fenko, H. N. Schifferstein, T. C. Huang, and P. Hekkert, „What makes products fresh: The smell or the colour?", *Food Quality and Preference*, 20(5), 2009, pp. 372–379.
- [31] B. J. Fogg, C. Soohoo, D. R. Danielson, L. Marable, J. Stanford, and E. R. Tauber, "How do users evaluate the credibility of Web sites?: a study with over 2,500 participants", In *Proceedings of the 2003 Conference on Designing for User Experiences ACM*, 2003, pp. 1–15.
- [32] D. Gefen, D. W. Straub, and M. C. Boudreau, "Structural Equation Modeling and Regression: Guidelines for Research and Practice", *Communications of the Association for Information Systems*, 4(7), 2000, pp. 1–78.
- [33] D. Gefen, I. Benbasat, and P. Pavlou, "A research agenda for trust in online environments", *Journal of Management Information Systems*, 24(4), 2008, pp. 275–286.
- [34] B. Greiner, "Subject pool recruitment procedures: organizing experiments with ORSEE", *Journal of the Economic Science Association* 1(1), 2015, pp. 1–12.
- [35] N. Guéguen and C. Jacob, "Coffee cup color and evaluation of a beverage's "warmth quality"", *Color Research & Application*, 39(1), 2014, pp. 79–81.
- [36] H. IJzerman and G. R. Semin, "The thermometer of social relations mapping social proximity on temperature", *Psychological Science*, 20(10), 2009, pp. 1214–1220.
- [37] O. Johansson-Stenman, M. Mahmud, and P. Martinsson, "Does stake size matter in trust games?", *Economics Letters*, 88(3), 2005, pp. 365–369.
- [38] Y. Kang, L. E. Williams, M. S. Clark, J. R. Gray, and J. A. Bargh, "Physical temperature effects on trust behavior: the role of insula", *Social Cognitive and Affective Neuroscience*, 6(4), 2011, pp. 507–515.
- [39] F. P. Karimov, M. Brengman, and L. Van Hove, "The effect of website design dimensions on initial trust: a synthesis of the empirical literature", *Journal of Electronic Commerce Research*, 12(4), 2011, pp. 272–301.



- [40] J. Kim and J. Y. Moon, "Designing towards emotional usability in customer interfaces—trustworthiness of cyber-banking system interfaces", *Interacting with Computers*, 10(1), 1998, pp. 1–29.
- [41] R. M. Kramer, "Trust and distrust in organizations: Emerging perspectives, enduring questions", *Annual Review of Psychology*, 50(1), 1999, pp. 569–598.
- [42] R. Küller, S. Ballal, T. Laike, B. Mikellides, and G. Tonello, "The impact of light and colour on psychological mood: a cross-cultural study of indoor work environments", *Ergonomics*, 49(14), 2006, pp. 1496–1507.
- [43] Lakoff, G. and M. Johnson, "Philosophy in the flesh: The embodied mind and its challenge to western thought", University of California, Berkeley and University of Oregon, Basic books, New York: Basic Books, 1999, pp.44–59.
- [44] C. P. Lamberton and R. L. Rose, "When is ours better than mine? A framework for understanding and altering participation in commercial sharing systems", *Journal of Marketing* 76(4), 2012, pp. 109–125.
- [45] P. Loos, R. Riedl, G. R. Müller-Putz, J. Vom Brocke, F. D. Davis, R. D. Banker, and P. M. Léger, "NeuroIS: neuroscientific approaches in the investigation and development of information systems", *Business & Information Systems Engineering*, 2(6), 2010, pp. 395–401.
- [46] D. Lynott, K. S. Corker, J. Wortman, L. Connell, M. B. Donnellan, R. E., Lucas, and K. O'Brien, "Replication of "Experiencing physical warmth promotes interpersonal warmth" by Williams and Bargh (2008)", *Social Psychology*, 45(3), 2014, pp. 216–222.
- [47] C. Maihöfner, M. Kaltenhäuser, B. Neundörfer, and E. Lang, "Temporo-Spatial analysis of cortical activation by phasic innocuous and noxious cold stimuli—a magnetoencephalographic study", *Pain*, 100(3), 2002, pp. 281–290.
- [48] B. Manav, "An experimental study on the appraisal of the visual environment at offices in relation to colour temperature and illuminance", *Building and Environment*, 42(2), 2007, pp. 979–983.
- [49] N. Matsubara, A. Gassho, Y. Kurazumi, "Facilitatory effects of environmental sounds on hue-heat phenomena", *Proceedings of the 18th International Congress on Acoustics ICA*, 2004, pp. 1775–1778.
- [50] K. A. McCabe, M. L. Rigdon, and V. L. Smith, "Positive reciprocity and intentions in trust games", *Journal of Economic Behavior & Organization*, 52(2), 2003, pp. 267–275.
- [51] R. Mehta and R. J. Zhu, "Blue or red? Exploring the effect of color on cognitive task performances", *Science*, 323(5918), 2009, pp. 1226–1229.
- [52] G. A. Michael and P. Rolhion, "Cool colors: Color-induced nasal thermal sensations", *Neuroscience Letters*, 436(2), 2008, pp. 141–144.
- [53] M. B. Müller, A. Hariharan, and M. T. Adam, "A NeuroIS Platform for Lab Experiments", in: Davis, F.; Riedl, R.; vom Brocke, J.; Leger, P.-M.; Randolph, A. (eds.), *Proceedings Gmunden Retreat on NeuroIS*, 2014.
- [54] J. C. Nunnally and I. J. Bernstein, "Psychometric Theory", 2nd Ed., New York: McGraw-Hill, 1967.
- [55] R. Riedl, F. D. Davis, and A. R. Hevner, "Towards a NeuroIS research methodology: intensifying the discussion on methods, tools, and measurement." *Journal of the Association for Information Systems*, 15(10), 2014, pp. i–xxxv.
- [56] C. M. Ringle, S. Wende, and A. Will, *SmartPLS - Release 2.0 M3*. 2005 (Available at <http://www.smartpls.de>)
- [57] M. Stirrat and D. I. Perrett, "Valid facial cues to cooperation and trust male facial width and trustworthiness", *Psychological Science*, 21(3), 2010, pp. 349–354.
- [58] N. J. Stone and A. J. English, "Task type, posters, and workspace color on mood, satisfaction, and performance", *Journal of Environmental Psychology*, 18(2), 1998, pp. 175–185.
- [59] S. Storey and L. Workman, "The effects of temperature priming on cooperation in the iterated prisoner's dilemma", *Evolutionary Psychology*, 11(1), 2013, pp. 52–67.
- [60] P. Valdez and A. Mehrabian, "Effects of color on emotions", *Journal of Experimental Psychology: General*, 123(4), 1994, pp. 394–409.
- [61] J. Vom Brocke, R. Riedl, and P. M. Léger, "Application strategies for neuroscience in information systems design science research", *Journal of Computer Information Systems*, 53(3), 2013, pp. 1–13.
- [62] B. Wicker, C. Keysers, J. Plailly, J. Royet, V. Gallese, and G. Rizzolatti, "Both of Us Disgusted in My Insula: The Common Neural Basis of Seeing and Feeling Disgust", *Neuron* 40(3), 2003, pp. 655–664.
- [63] L. E. Williams and J. A. Bargh, "Experiencing physical warmth promotes interpersonal warmth", *Science*, 322(5901), 2008, pp. 606–607.
- [64] J. Winzen, F. Albers, and C. Marggraf-Micheel, "The influence of coloured light in the aircraft cabin on passenger thermal comfort", *Lighting Research and Technology*, 46(4) 2013, pp.1–11.
- [65] W. Y. Wu, C. L. Lee, C. S. Fu, and H. C. Wang, "How can online store layout design and atmosphere influence consumer shopping intention on a website?", *International*

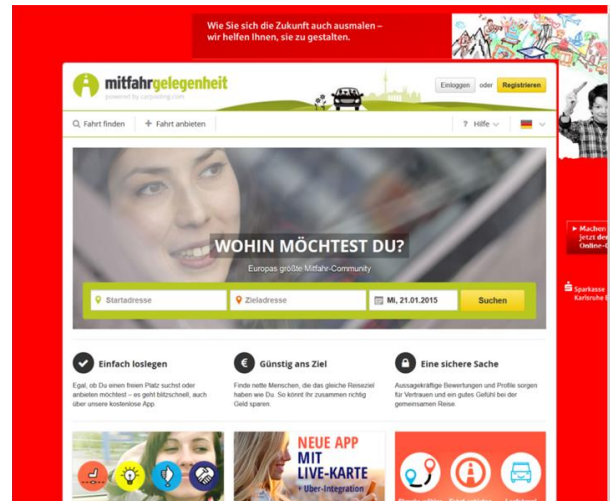
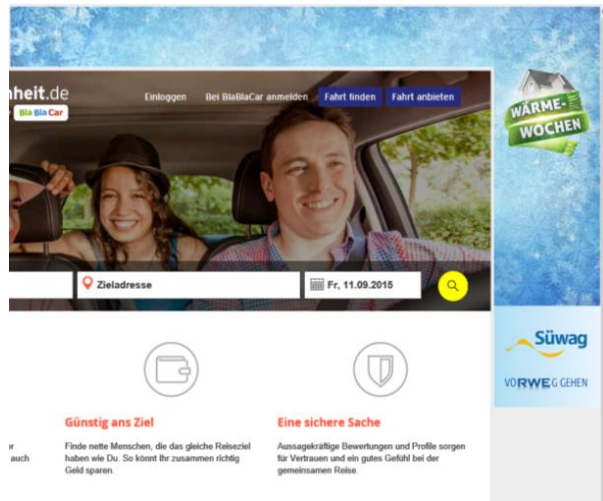
Journal of Retail & Distribution Management, 42(1), 2013, pp. 4–24.

[66] K. Yildirim, A. Akalin-Baskaya, and M. L. Hidayetoglu, “Effects of indoor color on mood and cognitive

performance”, Building and Environment, 42(9), 2006, pp. 3233–3240.

[67] C. B. Zhong and G. J. Leonardelli, “Cold and lonely does social exclusion literally feel cold?”, Psychological Science, 19(9), 2008, pp. 838–842.

## Appendix



**Figure A1. Colored advertising banners.**  
Blue and red advertising banners retrieved from the German ride sharing platform “mitfahrgelegenheit” ([www.mitfahrgelegenheit.de](http://www.mitfahrgelegenheit.de), 20-Jan-2015 and 10-Sep-2015).