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ABSTRACT

We report on a pilot study investigating the influence of financial stress and technostress on users' responses towards digital financial transactions. We developed a two-factor within-subject design, where techno-unreliability as variable system response time under time pressure and perceived financial loss were manipulated in a 3x2 design. We collected psychophysiological, perceptual and behavioral data from N=15 participants while performing an adapted version of the Iowa Gambling Task. The analysis reported decreased perception of system responsiveness, financial decision quality, electrodermal activity and variable heart rate in response to both manipulated factors. We posit that these results may indicate participants' disengagement towards the performance of a transactional digital financial task as a potential coping strategy in response to financial and technological stress. This pilot study contributes to further knowledge towards the understanding of the relationship between technology-related and financial stress.

Keywords
Technostress, Financial Stress, Techno-Unreliability, System Response Time, Digital Financial Transactions.

INTRODUCTION

Digital financial services institutions must attract and retain users to maintain profitability. Despite increasing adoption rates, continuance rates are still low. Studies report users' intention to stop using digital financial platforms and to eventually switch providers when facing unforeseen disruptions due to system malfunctions (e.g., Koghut and AI-Tabbaa, 2021). It is thus crucial for Information System (IS) research to investigate the motives of digital financial services discontinuance.

Research has identified these discontinuance behaviors as one coping strategy to avoid IS-caused threatening situations (Beaudry and Pinsonneault, 2005), such as technostress (TS) where discontinuance behaviors were more likely to occur among mobile application users after being exposed to unexpected critical technology incidents (i.e., techno-unreliability) (Salo and Frank, 2017). However, research has not fully explored techno-unreliability in the context of digital financial transactions (Korosec-Serfaty et al., 2021).

While TS has been approached as a phenomenon dissociated from other forms of stress, it is part of a complex range of interactions with other forms of stress (Korosec-Serfaty et al., 2020). Thus, to further understand discontinuance behaviors in the context of digital financial transactions, research must explore the relationship between TS and non-technological stress, such as financial stress (FS), due to perceptions of financial loss (Joo & Grable, 2004). As no study has focused on these relationships, this research investigates the influence of FS and TS on users' psychophysiological and behavioral responses towards digital financial transactions. To this aim, a pilot laboratory experiment simulating a realistic digital financial service context was conducted.

The findings of this pilot study offer results on the extent of users' responses in situations of exposition vs. non-exposition to FS and TS and develop future research avenues to disentangle their influence.

LITERATURE REVIEW & RESEARCH HYPOTHESIS

Digital Financial Services and Discontinuance

Digital financial services refer to a wide range of financial services (e.g., payments, credits, savings) accessed and delivered via digital channels (e.g., online platforms).

Whereas financial institutions embraced digital financial services rapidly, users have been hesitant to adopt them despite their benefits (Koghut and AI-Tabbaa, 2021). Therefore, financial institutions must carefully evaluate their readiness and willingness to adopt these services. IS research has mainly focused on the study of the adoption, intention to use, and continuance usage of these digital financial services.

However, studies report that users require reliable online financial service performance and express their intention to cease using these digital financial platforms and potentially

switch providers when confronted with technological disruptions (Koghut and AI-Tabbaa, 2021). Despite this, discontinuance usage behaviors have been overlooked by IS research in this context.

IS research indicates that continuance and discontinuance behaviors are part of the same continuum and that users' usage intentions may have different antecedents. For instance, users may choose to continue using IS out of habit (Turel, 2015), whereas they may cease using it as a coping strategy to avoid IS-threatening situations (Beaudry and Pinsonneault, 2005), such as TS. As such, users may disengage from IS when security requirements are perceived as overloading (D'Arcy et al., 2014) or quit using IS when its use is associated with negatively perceived IS incidents (Salo and Frank, 2017).

Technostress

Stress is a complex interplay between demands, referred to as stressors, and resources (Lazarus and Folkman, 1984). When the latter is perceived as insufficient to deal with a stressor, it will trigger responses that can be observed at various levels. Major physiological responses to the stressful event experience will prompt activation in specific regions of the brain, trigger the autonomic nervous system's sympathetic division (e.g., electrodermal activity elevation and heart rate acceleration) and activate stress hormones release (Riedl, 2013). Psychobehavioral responses to stress may lead to decreased productivity and diminished decision making and appear quickly after the stressful event (Korosec-Serfaty et al., 2021).

TS refers to the stress caused by the use of IS and the pervasiveness and expectations of their use in society (Riedl, 2013). It is conceptualized as a process activated by IS usage, where the latter acts as an interfering stressor. This process includes the presence of user, task, technology, and context characteristics referred to as antecedents that are appraised by users as taxing demands, namely technostressors, that require psychophysiological and behavioral efforts or coping strategies (Korosec-Serfaty et al., 2021). This study focuses on techno-unreliability, defined as a users' "perception of being confronted with unexpected behaviors of technologies, such as system breakdowns and delays in system response time (SRT)" (Fischer, et al., 2021, p. 3) as the technostressor (Riedl, 2013).

Variable length of SRT, defined as "the time delay between a user's initiation of a command on a digital device and the system's task completion, including the display of the result on the screen" (Riedl and Fischer, 2018, p. 175), have been linked to negative outcomes such as perceptions of uncertainty (Trimmel et al., 2003), impaired performance and decision making, changes in EDA, HR and heart rate variability (HRV) (Boucsein, 2009).

Financial Stress

FS is defined as the psychophysiological and behavioral responses resulting from financial or economic events in the sphere of financial resource management and decision making (Heo et al., 2020). It is operationalized through financial strain and the perception of an economic pressure which creates a potentially threatening situation. Personal stressors (e.g., perceived financial loss) were identified as financial strain sources (Joo and Grable, 2004). We identify perceived financial loss due to digital transactions as the financial stressor in the specific context of digital financial services.

Past research has shown significant relationships between FS and increased HR (Nag et al., 2017), lower performance, altered decision making, and disengagement as a coping mechanism (Wadsworth and Berger, 2006).

In conclusion, while the factors of TS and FS differ, their outcomes seem generally similar. The question now is to determine the extent to which the effects of TS and FS, and more specifically techno-unreliability and potential financial loss, affect users' responses and perceptions in the specific context of digital financial transactions.

Research Hypothesis

Based on these findings and to investigate the influence of FS and TS on users' responses towards digital financial transactions, we formulated the following hypothesis:

H1: Perceived financial loss and techno-unreliability as variable SRTs delays will influence physiological, perceptual, and behavioral responses and coping strategies.

METHODOLOGY

Participants

N=15 subjects (11 females; M = 24.7 years; SD = 4.7) took part in this study. Exclusion criteria included history of neuropsychiatric disorders and facial paralysis. The experiment was held in a NeuroIS laboratory. A session lasted 45 minutes. Subjects gave written informed consent to participate and received $25 as compensation. This study and its procedures were approved by the Council for Ethics in Research of the institution where it was conducted (certificate #2021-3910).

Experimental Design

A two-factor within-subject experimental design was used where SRT under time pressure (techno-unreliability) and FS were manipulated in a 3 [immediate SRT vs. short (2 s) SRT vs. longer (> 9 s) SRT] x 2 [financial gain vs. financial loss] design. Time pressure was added to match common situations and conditions experienced online (Riedl et al., 2013).

The experimental task consisted of an adapted computerized version of the Iowa Gambling Task (IGT), a paradigm used to study neurophysiological mechanisms underlying decisions under stress and uncertainty (Preston et al., 2007). Participants choose cards from four decks for 100 trials. Each card results in both a gain and a loss. However, two decks are disadvantageous (as they generate monetary gains and occasional significant monetary losses,

resulting in a net loss if selected too often). The other two are advantageous as they yield smaller gains and losses, resulting in a net gain. Deck selection is driven by acquired knowledge from trial 50 onward. Thereafter, a decision is considered as made under risk since the contingencies of the task are expected to have been learned.

In the current study, the task consisted of 120 IGT trials, divided into three blocks (1, 2, and 3). In each block, participants chose 40 cards from four decks. Similar to the original IGT, Decks A and B were disadvantageous, while Decks C and D were advantageous. Cards were presented face down, labelled A, B, C, and D below each deck. Initially, participants received a virtual amount of $2000 and were instructed to play the game with the objective of maximizing gains. Win/loss feedback was provided after each selection. Their accumulated total amount was displayed at the top right of the screen and updated after each choice. The decks were randomly shuffled at the start of each trial, but the labels always remained left to right. On-click card selection was self-paced and resulted in the win/loss subtotals updating between each round.

Each IGT trial's outcome constituted the financial stressor throughout each block. SRTs delays were induced as an animated spinning wheel appeared on the screen, momentarily preventing participants from selecting a card and carrying on their financial decision. Time pressure was induced by instructing participants to complete the task within three minutes. A stopwatch tracked time with a three-minute countdown.

Before the task, and to increase the SRTs' ecological validity, a five-second SRT delay interrupted participants while reading the task instructions and prior to the ten practice trials. Block 1 (control condition) involved performing the IGT without any time pressure. Block 2 and 3 consisted of performing the IGT under time pressure while being disrupted by randomized delays: 26 short and 26 longer delays, respectively. Between each block, a 2-minute video was shown to return participants to baseline.

Material and Apparatus

E-Prime 3 software (Psychology Software Tools, Pittsburgh, PA) was used to develop and administer the experimental task. Event markers were sent by E-Prime to Observer XT software (Noldus, Wageningen, NE). EDA and electrocardiogram (ECG) data were recorded with a Biopac MP-150 running via AcqKnowledge 4.4 software (Biopac Systems Inc., Santa Barbara, CA). Physiological data post-hoc synchronization was run via the CubeHX Photobooth software (Courtemanche et al., 2019).

Measures

EDA and ECG data were captured continuously during the experiment as autonomic nervous system measures. Frequency decomposition was applied to EDA data to derive skin conductance levels (SCL). SCL and heart rate response (BPM) data were down-sampled at 100 Hz from 256 Hz to produce one-second averages. These data were then segmented by experimental blocks.

Financial decision quality was recorded as a performance measure throughout the experimental task. The selection of Decks A or B represented disadvantageous financial decisions, while the selection of Decks C and D were regarded as advantageous financial decisions.

Perceptions of system responsiveness (7-point Likert scale) (Barnes and Vidgen, 2000) were measured upon completion of Blocks 1, 2 and 3. Perceptions of techno-unreliability (5-point Likert scale) (Fischer et al., 2021) were assessed after Block 3. All items were randomized.

Analysis

SCL and BPM raw data were standardized into z-scores and statistically processed using linear regression with random intercept (Holm–Bonferroni corrected) after outlier removal (mean +/- 3×SD). Perception of system responsiveness and techno-unreliability were averaged per participant and per block. Financial decision quality was calculated as the average of disadvantageous and advantageous decks for each block. Differences between blocks were assessed with paired-sample t-tests. Two participants were excluded from the SCL analysis due to unreadable data.

RESULTS

Perception of System Responsiveness

When comparing between blocks (N=15) (Figure 3), the system was perceived as significantly less responsive after completing Block 2 vs. Block 1 [μ=3.48; σ=1.38; t (14) =9.75; p <.0001], Block 3 vs. Block 1 [μ =4.13; σ=1.64; t(14)=9.75; p <.0001], and after completing Block 3 vs. Block 2 [μ =0.64; σ=0.63; t(14)=3.92; p = 0.002]. Thus, participants' perceptions exactly correspond to the objective SRT manipulations (immediate < short < longer).

Heart Rate

The analyses of BPM responses (N=15) (Table 1) indicate that participants displayed, on average, significantly lower heart rate in Block 2 than in Block 1 [t (1738) =2.63; p=0.02]. On average, participants displayed a significantly higher heart rate in Block 3 than in Block 1 [t (1738) =2.33; p=0.03]. However, there was no significant difference in heart rate between Block 2 and Block 3.

	Block 1	Block 2	Block 3
Mean	-0.20	-0.81	-0.07
SD	0.73	0.75	0.84

Table 1. Z-score (outliers removed) BPM by Blocks

Skin Conductance Levels

The analyses of SCL (N=13) (Table 2) responses indicate that the SCL averages were significantly lower in Block 2 than in Block 1 [t (1606) =17.27; p <.0001], in Block 3 than

in Block 1 [t (1606) =17.02; p <.0001], and in Block 3 than in Block 2 [t (1606) =12.24; p <.0001].

	Block 1	Block 2	Block 3
Mean	0.08	-0.004	-0.09
SD	0.96	1.00	1.01

Table 2. Z-score (outliers removed) SCL by Blocks

Effects on Financial Decision Quality

When comparing financial decision quality between blocks (N=15) (Figure 4), the number of disadvantageous decks selected was, on average, significantly higher in Block 1 than in Block 2 [t(1779)=6.12; p <.0001], and in Block 1 than in Block 3 [t(1779)=3.82; p=0.0013]. However, the number of disadvantageous decks selected remained significantly higher, on average, over the course of the experimental task [t(1779)=5.11; DF=1779; p <.0001].

Overall Perception of Techno-Unreliability

After the task, the system used was, on average, perceived as unreliable (N=15) (α=0.82; M =3.9; SD=0.71) as reported using the Fischer et al. (2021) five-point Likert scale (1=strongly disagree to 5=strongly agree).

DISCUSSION

These findings support our hypothesis that perceived financial loss and techno-unreliability as variable SRTs delays have an influence on users' physiological, perceptual, and behavioral responses and coping strategies.

In terms of perception of system responsiveness, the system used for the experimental task is perceived, on average, as significantly more responsive in the control condition after random exposure to FS and short SRTs delays (p <.0001) and longer SRTs delays (p <.0001) under time pressure. Similarly, the system was perceived as significantly more responsive after random exposure to FS and short SRTs delays than to FS and longer SRTs delays (p = 0.002) under time pressure. However, while the results were significantly different between blocks in terms of a decline in the perception of system responsiveness, the magnitude of the difference between exposure to short and longer SRTs was less than between the control condition and short SRTs. These findings are in line with research that shows the existence of a sensitivity curve associated with SRTs delays. Users typically perceive SRTs ≥ 0.2 seconds (Miller, 1968), while if SRTs increase further, they often become less sensitive. Consequently, the effects of longer SRTs, while still perceived as negative, fall outside of the sensitivity curve and are thus no longer perceived as negatively impacting the task in a linear relationship, potentially due to habituation.

Regarding physiological data, the results show that the average HR was significantly lower when being randomly exposed, under time pressure, to FS and short SRTs delays (p=0.02) compared to the control condition. However, it was significantly higher when exposed to FS and random longer SRTs delays when compared to the control condition (p=0.03). This supports previous research reporting that shorter SRTs result in lower HR (Boucsein, 2009) while longer SRTs result in higher HR (Riedl and Fischer, 2018). However, these studies did not consider time pressure as a contextual factor. In our case, this factor and the effect of FS on both HR and HRV will be further considered in future analyses.

The results indicate that the overall SCL responses were, on average, significantly higher during exposure to FS and immediate SRT when compared with exposure to FS and random short SRTs delays (p <.0001) and exposure to FS and random longer SRTs delays under time pressure (p <.0001). However, on average, the overall SCL responses were significantly lower while facing FS and random longer SRTs delays under time pressure than when exposed to FS and random short SRTs delays under time pressure (p <.0001). Contrary to previous findings (Riedl and Fischer, 2018; Trimmel et al., 2003), these results report a linear decrease in SCL in response to progressively longer SRTs under time pressure. We posit that these findings are potentially due to a habituation effect related to the perception of system responsiveness, whereby participants eventually disengage with the task. Further analyses, including skin conductance response (SCR) data, may provide additional insights to illuminate this effect.

With regards to the behavioral and coping strategy responses, financial decision quality was used as a performance measure. While completing the IGT, participants selected, on average, more disadvantageous decks while being exposed to FS and immediate SRTs when compared with being exposed to FS and random short SRTs delays (p <.0001) and to longer SRTs delays under time pressure (p=0.0013). Yet, on average, participants selected more disadvantageous decks in all three conditions (p <.0001). The expectation was that conditional learning of the contingencies of the decks would be acquired after the first 50 trials, and thus select more advantageous decks thereafter (Preston et al., 2007). Contrary to this expectation, our results indicate that more disadvantageous decks were selected throughout the experiment regardless of the conditional learning effect. This finding, combined with the observed effect of decreased arousal (SCL) and the general perception of high system unreliability (M =3.9, scale 1-5), may be an indication of participants' disengagement towards the performance of the task as a potential coping strategy in response to financial and technological stress.

LIMITATIONS & FUTURE RESEARCH

This pilot study focused on the combined influence of FS and TS on users' responses. In future research, we will use additional data and triangulation analysis to disentangle both forms of stress and assess the extent of the impact of perceived financial loss and each duration of SRT under time pressure upon financial decision quality and IS disengagement as a potential coping strategy.

CONTRIBUTION AND CONCLUSION

The findings of this pilot study indicate that there is indeed an influence of perceived financial loss and techno-unreliability (as variable SRTs delays) on users' physiological, perceptual, and behavioral responses and coping strategies. This influence takes the form of decreased perceived system responsiveness, variable HR, decreased SCL and decreased financial decision quality in response to FS and random variable SRTs delays under time pressure.

Our future research will seek to address a gap in the literature on the potential interaction between TS and FS and the extent of their influence on users' responses and coping strategies and investigate IS discontinuance behaviors in the context of digital financial services. This future research will also provide guidelines on mitigating the impact of SRTs, FS and TS and their effects on discontinuance behaviors.

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