Gamifying Digital Work: An Empirical Investigation How Gamification Affects IS Use Appraisal

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Abstract

Information systems (IS) and their healthy use are becoming increasingly important in the digital work environment. The cognitive appraisal of an IS-enabled demand is decisive for if IS use leads to positive or negative outcomes. This work investigates how gamification integrated into IS can support challenge appraisal and reduce threat appraisal of IS-enabled demands. We conducted an online experiment to examine the impact of gamification on appraisal. We simulated time urgency in a gamified IS and examined how challenge and threat appraisal developed among participants during the experiment. We examined the panel data with a Latent Growth Model and find that gamified IS does not initially reduce threat appraisal but reduces it over time. Challenge appraisal is not significantly higher among users working in gamified IS. That this hypothesized effect does not show in the data might require further research. Our paper contributes to a better understanding of the cognitive appraisal process in IS use research and identifies gamification as a valuable tool to positively influence the cognitive appraisal process.

Keywords: IS Use, Gamification, Appraisal, Latent Growth Models

1. Introduction

Modern information systems (IS) have become ubiquitous in private and business lives, enabling many benefits such as facilitated work routines, higher performance, or new ways of working (Dittes & Smolnik, 2019). During the COVID-19 pandemic, IS for communication and collaboration supported the transformation of many workplaces towards telework and enabled sustained social contacts (Ketter et al., 2020). Yet, previous research indicates that the use of IS might also lead to adverse psychological effects among employees, such as increased psychological exhaustion (Tarafdar et al., 2007). Such negative outcomes can be triggered by IS-enabled demands, which are "objective demands that are enabled by IS and [may] stress individuals" (Galluch et al., 2015, p. 3). Further, research findings support that users may also perceive IS-enabled demands as a challenge that may provide opportunities for personal growth and empowerment when successfully overcome (Benlian, 2020; Le Fevre et al., 2003). Congruently, literature considers IS use as a dual phenomenon with bright and dark sides (Tarafdar et al., 2019). The cognitive appraisal offers an explanation of different reactions in objectively identical situations (Krohne, 2001). Influencing the individual's appraisal towards appraising the IS-enabled demand as challenging instead of threatening can potentially decrease the adverse consequences of using IS. Designing IS in a way that gives users the impression that they can successfully deal with IS-enabled demands is considered a possible approach to positively influence the individual's cognitive appraisal (Johnson & Wiles, 2003; Tarafdar et al., 2019). Therefore, IS design features might have the potential to positively impact the perception of stress. For example, IS design features that empower users and encourage them could help diminish negative experiences by increasing user motivation and enjoyment (Tarafdar et al., 2019).

The gamification domain indicates that gamification elements can motivate users, for example, by giving them feedback about their performance (Zichermann & Cunningham, 2011). Therefore, a promising approach to positively influence IS use appraisal could be the integration and application of gamification (Tarafdar et al., 2019). Gamification refers to "the use of game design elements in non-game contexts" (Deterding et al., 2011, p. 2). Previous research suggests its effectiveness in supporting engagement, motivation, and promoting the users' well-being by generating positive experiences and emotions, or satisfying basic

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needs (Hamari et al., 2014; McGonigal, 2011). However, research has not yet investigated the potential of gamification to influence the cognitive appraisal process. Thus, in this study we assess its ability to support challenge appraisal and reduce threat appraisal concerning IS-enabled demands. Congruently, we follow the research question: *Does the influence of gamification on cognitive appraisal reduce threat appraisal and support challenge appraisal of an IS-enabled demand?*

To answer the question, we conducted an online experiment in which we simulated an environment where users must process an unknown number of work tasks under time urgency. Previous research suggests that such situations can create both challenge and threat appraisals (Benlian 2020). We collected data at different points in time during the experiment and analyzed them with a Latent Growth Model (LGM). We contribute to existing research by considering the positive impact of gamification on cognitive appraisal. We show how gamification might help to influence the appraisal of an IS-enabled demand as a challenge and reduce threat appraisal. Besides the benefits for research, managers, and software developers can profit by adapting their IS accordingly.

2. Theoretical Background

2.1 Stress Appraisal Leading to a Bright and Dark Side of IS Use

From the transactional-based approach, stress comprises an ongoing procedure that entails an exchange between the individual and the environment (Lazarus & Folkman, 1984). When encountering an environmental demand, individuals determine whether it is relevant and considerably strenuous for their resources. Next, individuals make appraisals to classify the personal implications of the encounter (Lazarus & Folkman, 1984). The person assesses the degree to which the transaction between the individual and the environmental demand is positive, irrelevant, or stressful (primary appraisal) and whether they have the required resources to deal with this demand (secondary appraisal) (Lazarus & Folkman, 1984). The appraisal can be categorized as a threat which indicates the possibility of future harm, or as a challenge that indicates a potential for mastery, growth, or benefit (Lazarus & Folkman, 1984). Several different paths to a positive perception of the environment are described in stress research, e.g.: overcoming hardship, successfully overcoming stressful situations, opportunities to grow, or inherently enjoyable activities (e.g., Edwards & Cooper, 1988). In this paper, we follow a more positive definition of challenge as an opportunity for mastery and growth (c.f., LePine et al., 2016). It must be considered that challenge and threat appraisal are not mutually exclusive but can coincide to varying degrees (Schwarzer, 1992). Thus, stress is a dualistic phenomenon and can be harmful and positive for an individual (Selye, 1976).

This conceptual understanding of the stress process also applies to technostress (Tarafdar et al., 2019). Technostress is a phenomenon triggered by the use of IS and has been conceptualized as a process in the context of numerous studies (e.g., Ragu-Nathan et al., 2008). While previous research has focused on the negative side of IS use and its implications, recent literature shows that IS-enabled demands can also have positive effects that may primarily result from challenge appraisals rather than threat appraisals (Tarafdar et al., 2019). Depending on the appraisal of IS-enabled demands, previous research indicates that IS use can lead to both desirable (e.g., satisfaction, higher productivity) and avoidable (e.g., poor health, strain) outcomes (Gimpel et al., 2019).

IS-enabled demands are the "objective demands that are enabled by IS and [may] stress individuals" (Galluch et al., 2015, p. 3). Based on a literature review, Benlian (2020) identified, for example, time urgency as a challenging work stressor and has placed it in an IS-related context. Benlian (2020) identified some conceptual overlap between time urgency and techno-overload. On the one hand, and related to time urgency, IS use can be considered a leverage that helps users handle and accomplish more work (challenge appraisal),on the other hand, IS can be appraised as forcing users to work more and faster than they can (threat appraisal) (Benlian, 2020). Therefore, working in a demanding IS environment is not always seen as a challenge (bright side of IS use) but can also be seen as a burden and lead to adverse effects (dark side of IS use) (Benlian, 2020). Similar results were found by Califf et al. (2020) who substantiate that not all currently recognized techno-stressors are associated with threat appraisals.

To date, IS literature lacks knowledge about what influences cognitive appraisal. There has been little research on IS design features influencing the appraisal process and their possibility to support challenge appraisal of an IS-enabled demand (Tarafdar et al., 2019). Promising IS design features in that regard are game design elements.

2.2 Theoretical Foundations of Gamification

The motivational mechanism of gamification can be used to support long-term behavior changes by making applications more exciting and enjoyable

(Hamari et al., 2014). Gamification is about incorporating elements that are characteristic and typical for games into a real-world context (Deterding et al., 2011). Examples of game design elements include *badges*, *progress bars*, *points*, or *notifications* (Koivisto & Hamari, 2019). *Badges* are symbolic honors users can obtain within a game (Sailer et al., 2013). The users can determine their progress on a *progress bar* and receive information about whether they are approaching their goals (Sailer et al., 2013). Users can collect *points* for specific activities within the gamified environment (Sailer et al., 2013). Lastly, *notifications* provide users with motivational and informative feedback based on their performance (Buchem et al., 2019). The application areas, among others, include contexts in work, teaching, and health (Arai et al., 2014; Johnson et al., 2016; Koivisto & Hamari, 2018). Studies show, for example, that the integration of game design elements in stress management applications is perceived positively by users and increases their commitment (Dennis & O'Toole, 2014; Hoffmann et al., 2019). Additionally, game design elements can instantly lead to wellbeing. Gamification can support the emergence of positive experiences by fulfilling fundamental psychological needs and other aspects of wellbeing such as positive feelings, accomplishment, giving sense, and engagement (Johnson et al., 2016; McGonigal, 2011; Pereira et al., 2014). There are several studies on the influence of gamification on flow experience, which show mainly positive results (Oliveira et al., 2021). Flow is defined as a condition of pleasure, inspiration, total engagement and an uplifting sense of transcendence (Csikszentmihalyi, 1998).

Concerning mental health, studies have examined the effect of gamification in detail. Research results indicate that gamification can positively affect mental wellbeing, personal growth, and flourishing while reducing anxiety (Dennis & O'Toole, 2014; Hall et al., 2013). The high number of studies examining the influence of gamification on mental health have found positive or mixed results (Johnson et al., 2016).

2.3 Impact of Gamification on Stress

Few studies focus on the negative (e.g., Hammedi et al., 2021; Yang & Li, 2021) or positive influences (Fajri et al., 2021; Paniagua et al., 2019; e.g., Tennakoon & Wanninayake, 2020) of gamification on the experience of stress. Regarding the adverse effects, for example, Hammedi et al. (2021) found that employees can feel stressed about whether or not to pass a challenge delivered via gamification (Hammedi et al., 2021). Nevertheless, Paniagua et al. (2019) found a positive relationship between chemical engineering students using a gamified learning platform and reducing their stress levels. Furthermore, Tennakoon & Wanninayake (2020) confirmed the moderating effect of gamification in the workplace regarding its impact on work stress and employee performance. Finally, Fajri et al. (2021) found that gamification can increase the playfulness of digital learning management systems and reduce technostress.

3. Hypothesis Development

A gamified IS can make a user's performance visible, for example, through *points* or *badges* received for completed work (Sailer et al., 2013). This reward mechanism provides the user with motivating feedback and immediate reinforcement and thereby reaffirms the user's abilities (Hamari & Eranti, 2011; Rigby & Ryan, 2011; Sailer et al., 2013). This way, users receive recognition and praise for their performance in the gamified IS (Antin & Churchill, 2011). Hence, users feel confident that working in a gamified IS will positively affect them and is a chance to demonstrate their abilities. Subsequently, users perceive the IS-enabled demand as a challenge to keep up their good performance and further develop their skills to earn additional rewards (Csikszentmihalyi, 1998; Hamari et al., 2014). At the same time, motivational feedback, for example through the receipt of *notifications* and changes in a *progress bar*, can help users to better assess their performance in an IS and give them clarity about the situation (Waldersee & Luthans, 1994). For instance, users who receive a praising *notification* and take a step in *a progress bar* after accomplishing a work task know they have completed it correctly and are assured about their abilities. This feedback can reduce users' feelings of insecurity and fear that the work results will have negative consequences for them (Levy et al., 1995). The playful design of IS and encouraging feedback may make an IS-enabled demand less threatening for the user. Thus, a gamified IS has several capabilities to help promote challenge appraisal and reduce threat appraisal of an IS-enabled demand, leading to the following hypotheses:

H1: Users of a gamified IS have an initially lower (H1a) and stronger decreasing (H1b) threat appraisal in association with an IS-enabled demand than users of a non-gamified IS.

H2: Users of a gamified IS have an initially higher (H2a) and stronger increasing (H2b) challenge appraisal in association with an IS-enabled demand than users of a non-gamified IS.

4. Methodology

4.1 Design and Realization of the Experiment

We conducted an online experiment to evaluate the research model by simulating an IS-enabled demand related to time urgency. It is considered a stress factor that users can appraise as both a threat (i.e., the perception of IS as a force to work faster) (Tarafdar et al., 2007) and a challenge (i.e., the perception of IS as a support to work faster) (Benlian, 2020). Hence, it is well suited to analyze the cognitive appraisal process. As a means to an end, we designed a digital assessment system (DAS) containing gamification elements. We generated the IS-enabled demand in which participants must process work tasks provided via email in an inbox under time urgency. It is assumed that participants are familiar with the use of email inboxes. Using LabVanced, we created a DAS interface that corresponds to the design and functionalities of an email inbox. We chose different intelligence test exercises as tasks embedded in an email frame, e.g., completing missing numbers or abstract figures in a series of them, solving arithmetic problems, drawing logical conclusions from given assertions, or memory exercises. The difficulty level of the tasks was easy to medium in order to avoid that the difficulty of the tasks would cause stress, which might distort the result. The participants had four minutes for each round so that they could complete them just under the allotted time but dosed them so that participants experienced some time urgency.

We integrated gamification into the DAS to manipulate the appraisal of the IS-enabled demand in the intervention group. For that, we included a *point* system, *notifications*, *progress bars*, and *badges* in the DAS. Participants received points for completed tasks and for correct answers which were displayed immediately on the screen. Collected points were summarized in a point bar which was always visible. The *notifications* contained motivating and informative messages like "You have successfully solved the task, keep it up!". They also appeared after finishing a task. During each round, a *progress bar* showed participants how many tasks had been completed and how many still needed to be completed within the time, allowing participants to manage their time. Note: not all messages in the inbox contained tasks. The *badges* were displayed after each round to reward the overall success of a round (e.g., Promising Candidate Level 1).

The online experiment was separated into a pre-experimental, experimental, and post-experimental stage (see Figure 1). In advance, we carried out pilot tests to improve the experimental stages. Following the advice of Cook et al. (1970), we chose a purpose that prevents participants from identifying the true purpose of the experiment to avoid demand characteristics bias. In the pre-experimental stage, participants are briefed that they serve as test persons to examine a DAS for employee recruitment. Participants were informed about the study procedure, the number of rounds, and data protection aspects. Next, participants were asked to imagine that they applied for a job they were willing to be hired for and were invited to participate in a DAS to demonstrate their skills. Participants were introduced to the DAS and the expected tasks in detail. After the introduction, participants had to fill out the first survey, which assessed *self-efficacy* and *stress mindset*.

The experimental stage began with participants entering the email inbox interface. They could start opening emails and working on the tasks. Continuously, new emails arrived. A round in the DAS contained seven to eight emails with five to six exercises. If participants completed all tasks before the end of the four minutes, they could finish early. After each round, participants had to complete a survey. The surveys during the experimental stage asked participants for their *perceived threat appraisal* and *challenge appraisal* regarding their personal use of the DAS.

The post-experimental stage started after participants completed the four rounds in the DAS. We collected demographic data on age, gender, and education level. Finally, we thanked the participants for completing the experiment and explained the actual goal of the study.

We recruited participants via Amazon Mechanical Turk (MTurk). The experiment lasted 30 minutes. Participation was voluntary and was paid

Treatment Group	**Preexperi-mental Stage**	**Experimental Stage**								**Postexperi-mental Stage**
Gamification Group	Introduction and Survey 1	Task block 1 Gamification	Survey 2	Task block 2 Gamification	Survey 3	Task block 3 Gamification	Survey 4	Task block 4 Gamification	Survey 5	Survey 6
Control Group	Introduction and Survey 1	Task block 1	Survey 2	Task block 2	Survey 3	Task block 3	Survey 4	Task block 4	Survey 5	Survey 6

Figure 1. Experimental procedure

$4.10. 120 runs were conducted. The final sample included 89 subjects, as we excluded participants based on missed attention checks. Most are between 30 and 39 years old (29.2%), followed by 40 to 49 (25.8%). 57.3% of the participants are men, and 42.7% are women. Most completed vocational training (47.2%). The remaining have a lower school leaving certificate (29.2%), high school diploma or equivalent (16.9%), or a bachelor's degree (6.7%). Participants were randomly assigned to one of the two groups.

4.2 Measurements

Threat appraisal was assessed by applying four items for perceived threat (adapted from Bala & Venkatesh (2015) and Major et al. (1998)). *Challenge appraisal* was measured using four items for perceived opportunity (adapted from Bala & Venkatesh (2015), Major et al. (1998), and Drach-Zahayy & Erez (2002)). As mentioned, there are several interpretations of challenge appraisal in the literature ranging from overcoming hardship, to successfully overcoming stressful situations and opportunities to grow. This is a rather positive operationalization. We adjusted the items by applying them to the context of the DAS and the simulated stressor time urgency. Thus, for example, we changed "the system" from the original item to "digital assessment system": "I am confident that the system will have positive consequences for me." (Bala & Venkatesh, 2015, p. 170) was adjusted to "I am confident that the digital assessment system will have positive consequences for me." Additionally, we changed and specified "the situations caused by the system" to "the number of tasks, information and time pressure" (e.g., "I personally have what it takes to deal with the number of tasks, information and time pressure"). The remaining items have been adjusted similarly.

Various studies identified differences in the perception of IS use between individual characteristics of users: *gender*, *age*, *stress mindset*, *self-efficacy*, and *educational level* (Ayyagari et al., 2011; Ragu-Nathan et al., 2008). For this reason, we controlled that the two groups do not differ in these variables. *Self-efficacy* was measured using the generalized self-efficacy scale from Schwarzer & Jerusalem (1995). *Stress mindset* was determined with items adapted from Crum et al. (2013). We measured all constructs with a 7-point Likert scale (strongly disagree to strongly agree).

4.3 Data Analysis: Latent Growth Modeling

We applied a data analytic approach to study our assumptions and used an LGM analysis to test the hypotheses. An LGM enables the investigation of a construct's initial value and trajectory over time. It allows a broad class of statistical methods that offer several advantages in analyzing longitudinal data (Diallo & Morin, 2015). First, LGMs provide improved statistical power, and second, LGMs allow the study of intraindividual changes over time (i.e., changes within individuals over time) as well as the study of interindividual variability in intraindividual changes (i.e., individual differences in changes over time; Diallo & Morin, 2015; Felt et al., 2017). For these reasons, this method is very suitable for analyzing our data. In the first step, LGMs were investigated separately for the intervention and control group for threat appraisal and challenge appraisal. We applied the functional form of a linear growth model. The following quality criteria were considered and analyzed for each LGM: root mean squared error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and standardized root mean square residual (SRMSR).

The data sets of the two treatment groups were merged to determine whether there were significant differences between the intervention and control group in slopes and intercepts for threat appraisal and challenge appraisal. We calculated the LGM of the combined dataset. We integrated a dummy variable that measured the group membership. The dummy variable displayed a time-invariant covariate and measured the additional effect (i.e., the difference between the treatment groups) of gamification in the intervention group on slope and intercept. The values of the control group represented the base (dummy variable = 0, intervention group =1). The difference in the height of slope and intercept between the treatment groups was tested for its significance. For the analyses, we used Microsoft Excel and the statistics software R.

5. Results

In the following, we describe the results for the threat appraisal of the control group (Figures 2 and 3). A linear growth model is assumed here, which fits quite well to the data (CFI = 0.99, TLI = 0.99, SRMR = 0.08, RMSEA = 0.08). The initial level is 2.934 and significant (p = 0.00). The linear slope is 0.041 but not significant (p = 0.38). Next, the LGM for threat appraisal of the intervention group is presented. The quality criteria indicate that the fit of a linear growth model is very good (CFI = 1.00, TLI = 1.00, SRMR = 0.02, RMSEA = 0.00). The initial level is 2.554 and significant (p = 0.00). The trajectory value for the linear slope is -0.108 and indicates a significant (p = 0.00) slight decrease in perceived threat at each measurement time. The investigation of group differences shows that there are no significant

differences in the initial value between the treatment groups and that there is a significant difference between the linear slopes of the treatment groups (estimated markups in the intervention group: Intercept: -0.380, p = 0.22; Slope: -0.154, p = 0.00). Thus, the hypothesis (H1a) that users of a gamified IS have an initially lower perception of threat associated with the IS-enabled demand than users of a non-gamified IS must be rejected. The hypothesis (H1b) that users of a gamified IS have an over time stronger decreasing perception of threat in association with the IS-enabled demand to users of a non-gamified IS can be supported.

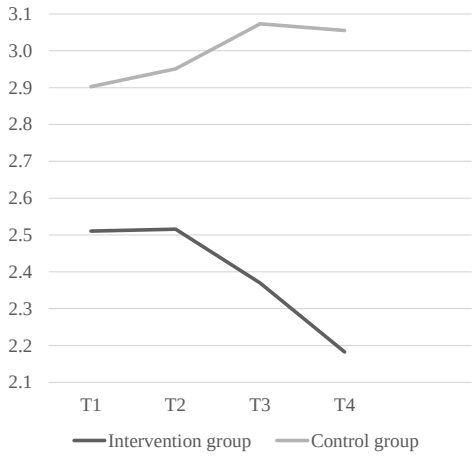

Figure 2. Trajectories of threat appraisal

The next LGMs considered are for challenge appraisal (Figure 4 and 5), starting with the control group. The quality criteria show an acceptable fit of the linear model (CFI = 0.91, TLI = 0.89, SRMR = 0.14, RMSEA = 0.32). The initial level is 5.110 and significant (p = 0.00). The value for the linear slope is 0.012 and not significant (p = 0.71). Finally, the LGM of the intervention group for challenge appraisal is examined. The quality criteria indicate that the fit of the used linear model is very good (CFI = 0.98, TLI = 0.98, SRMR = 0.05, RMSEA = 0.14). The initial level is 5.651 and significant (p = 0.00). The trajectory value for the linear slope is 0.033 and not significant (p = 0.23). The study of group differences indicates no significant differences in the intercepts of the two treatment groups. Furthermore, there are no significant differences in the slopes between the two treatment groups (estimated markups in the treatment group: Intercept: 0.409, p = 0.09; Linear slope: 0.077, p = 0.09). Hence, the hypothesis (H2) that users of a gamified IS have an initially higher and over time stronger increasing challenge appraisal in association with the IS-enabled demand to users of a non-gamified IS, must be rejected. Yet, given the low sample size of this study and the relatively low p-values (p=0.09), these results should be taken with a grain of salt.

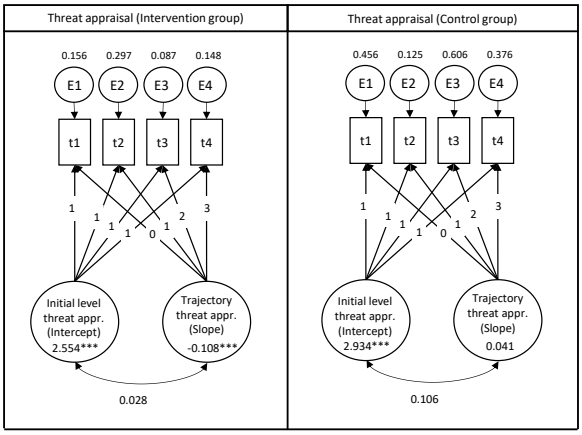

Figure 3. LGM results for threat appraisal

*(Note: p > 0.05, p** < 0.05, p*** < 0.01, E = error variance, t# = time point, ↔ = covariance, numbers on arrows represent the factor loadings of a linear growth model; appr. = appraisal)*

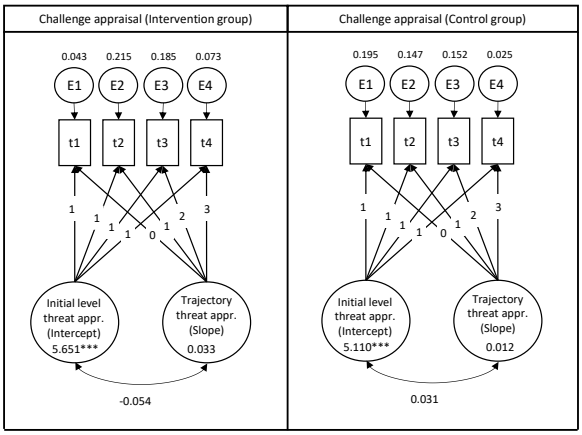

Figure 4. LGM results for challenge appraisal

*(Note: p > 0.05, p** < 0.05, p*** < 0.01, E = error variance, t# = time point, ↔ = covariance, numbers on arrows represent the factor loadings of a linear growth model; appr. = appraisal)*

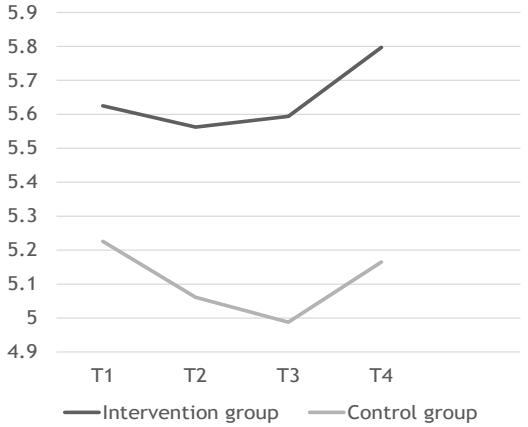

Figure 5. Trajectories of challenge appraisal

6. Discussion

This study focuses on investigating the cognitive appraisal process when using IS. We analyze if gamification can contribute to challenge appraisal and decreases threat appraisal. First, we hypothesized that the initial value and the slope for threat appraisal were lower in the intervention group than in the control group throughout the experiment (H1). After the first round of the experiment, the treatment group did not appraise the IS-enabled demand as a threat significantly differently from the control group (H1a: rejected). Retrospectively, this result might be explained by the increased complexity of the gamified user interface and the additional information users must process in the treatment group. The complexity might initially offset the positive effects of gamification. Our result is congruent with Yang & Li (2021). They provide evidence that gamification can be associated with the stressor techno-overload, which is inherently appraised as a threat (Tarafdar et al., 2019). However, after some time working with the gamified IS, participants of the intervention group appraised the IS-enabled demand as significantly less threatening than the control group, as evidenced by a significantly negative slope (H1b: supported). This shows gamification's positive effect. Gamification has been shown to motivate and support IS users (Johnson et al., 2016; Sailer et al., 2013). Those two factors have been associated with the appraisal of IS (Tarafdar et al., 2019). In our experiment, the gamified IS was designed to make users feel that their work with the IS would have no adverse effect on their performance (badges) and made it easier for them to assess the demands (progress bar). Evidently, that made them perceive less threat appraisal. Hence, we conclude that a gamified IS can significantly reduce perceived threats over time. This finding is enabled by our longitudinal research design.

Second, we examine whether a gamified IS can help increase the appraisal of an IS-enabled demand as a challenge. We hypothesized that the initial intercept and the slope for challenge appraisal were both higher in the intervention group than in the control group (H2) – mainly because users are encouraged by the motivating effect of gamification (Sailer et al., 2013). This effect is primarily driven by badges that set goals for users and provide positive feedback upon their reception. Contrary to our hypothesis, challenge appraisal is not significantly higher in the intervention group than in the control group after the first round of the experiment (H2a: rejected). Yet, the mean value is higher for the gamification group and given the relatively small sample size as well as the p-value of 0.09, this may encourage further research into the issue. During the experiment, participants in the intervention group appraised the IS-enabled demand as constantly higher as a challenge than the participants in the control group, yet the difference is again not significant. Results from research on the effect of gamification on flow indicate that gamification has the power to create positive engagement and psychological reactions by setting goals and providing feedback or rewards (Oliveira et al., 2021). Roh et al. (2016) show that gamification is a valuable way to increase employees' motivation and positive experience by generating flow through playful goals and feedback.

Further analysis of challenge appraisal reveals that the participants in both treatment groups do not experience a significant change over time. The trajectories of the slopes are quite similar for both treatment groups and do not differ significantly. This is against our expectations (H2b: rejected). Previous research suggests that after the first interaction in a gamified interface, users initially seek feedback to maximize positive affective states (Hamari et al., 2014; Levy et al., 1995). However, this perception decreases over time, which Hamari et al. (2014) call the novelty effect. Csikszentmihalyi (1998) argues that a positive form of stress appears when an individual is fully involved in facing a challenge that is barely manageable. If users are not challenged further, they become increasingly bored (Przybylski et al., 2010). We did not implement an increase in difficulty, so participants may not have been challenged enough to experience the hypothesized increasing effect.

Several studies show that gamification can contribute to stress reduction and are in line with our research results (e.g., Fajri et al., 2021; Tennakoon & Wanninayake, 2020). Fajri et al. (2021) show in the context of technostress and e-learning that gamification can provide pleasure, lowering the users' negative stress levels (threat). Our results confirm this and shed light on how threat appraisal changes over time – an intra-situational view that has scarcely been investigated. These results indicate that gamification reduces users' resistance to work and increases the effectiveness of IS implementation (Fajri et al., 2021).

Our empirical results do not support our hypotheses regarding the positive side of stress (challenge appraisal). While there is a difference between the control and gamification groups, it is not significant. Hussain et al.'s (2018) results show that a gamified work environment increases employee engagement, commitment, and motivation while positively impacting employees' mental health and stress perception. Thus, we encourage future research to investigate the subject from an intra-situational longitudinal perspective.

6.1 Theoretical and Practical Contribution

The positive side of IS use in demanding situations and the underlying mechanisms are still unexplored (Tarafdar et al., 2019). Recent literature suggested that a motivating gamified IS design could help individuals appraise an IS-enabled demand as a challenge rather than a threat (Tarafdar et al., 2019). We find empirical support for its ability to reduce threat appraisal, yet our results stop short of showing a significant positive effect on challenge appraisal. Our results imply several theoretical contributions.

First, we address the call for research by Tarafdar et al. (2019) to explore the role of cognitive appraisal in the context of the technostress process more comprehensively. Our results show whether IS-enabled demands related to time urgency are appraised as a threat or a challenge that can be affected through IS design elements. We provide insights that a gamified IS using the elements of progress bars and badges can reduce threat appraisal. Second, we show how this effect develops over time. Stress is a process, and previous research has indicated that appraisal may vary over time (e.g., Schwarzer, 1992). Our results show that gamification gradually helps individuals in reducing their threat appraisal over time (as indicated by a negative slope in the intervention group). Per our design, this may be due to feedback received. Third, this work contributes to the gamification literature by increasing the knowledge about its influence on the perception of IS use. Gamification researchers have primarily studied the context of flow which they consider a separate construct and research stream than stress (for a literature review: Oliveira et al., 2021). Our work addresses the effect of gamification on challenge and threat appraisal of IS-enabled demands. To the best of our knowledge, it is the first to do so following an intra-situational perspective over time. It provides first insights that gamification is a meaningful tool to positively influence the appraisal of IS-enabled demand by reducing threat appraisal.

Our work also provides practical implications on how threat and challenge appraisal of an IS user can be influenced. Building on our findings, we recommend that organizations and software providers gamify IS to affect their users' perception of stress. Our experiment shows one possible implementation that offers progress bars, feedback, and badges. For example, Microsoft Outlook offers the possibility to create tasks from emails that could be utilized to implement such a design. However, gamification can also be implemented into other work systems and in other forms. Through gamification, users perceive working with an IS as less threatening, which can reduce several adverse outcomes. Nevertheless, our study shows that the effect of gamification does not set in immediately but only after a certain period in which users become accustomed to the gamified IS.

6.2 Limitations and Future Research

Like all studies, this study has limitations that allow for additional research. First, our empirical results regarding challenge appraisal could not support the hypotheses theoretically derived from literature. We attribute this to an experimental design that did not increase the difficulty to counteract the novelty effect (Hamari et al., 2014) and a limited sample size. Second, our experimental design was intended to simulate an IS-enabled demand related to time urgency that can be appraised both as a challenge and a threat (Benlian, 2020). Transferability and generalizability of our findings to other IS-enabled demands need to be established. Also, our design is limited in creating an actual work situation involving aspects like workforce, working in multiple IS simultaneous, task complexity, and external interruptions. Yet, by recruiting MTurks for this task, we aimed to simulate a real work scenario in our experiment. Third, this study focuses on achievement-related gamification elements (e.g., points). Future research might consider investigating immersion-related elements (e.g., avatars, story-telling) and social-related elements (e.g., interactions) (Xi & Hamari, 2019) and their effect on appraisal. Lastly, we required multiple data points to analyze the perception of the different constructs as a trajectory over time (Kline, 2015). Therefore, participants interrupted the work in the experimental interface after each round by answering surveys. This procedure was necessary to collect data at four points in time. However, the interruptions could have led to distractions.

7. Conclusion

This work aims to understand better how gamified IS can positively influence the cognitive appraisal process toward supporting challenge appraisal and reducing threat appraisal. We developed a research model and measured the impact of gamification on the challenge and threat appraisal in an online experiment. We created a work situation that simulated IS-enabled demands related to time urgency. The interface of the intervention group contained various gamification design elements aimed at affecting appraisal. We analyzed appraisal from an intra-situational perspective and collected data at four different times during the experiment. The data was analyzed using LGMs. We find that after a familiarization phase, users of a gamified IS found the situation to be

continuously less threatening than users of a non-gamified IS. Contrary to our hypotheses, it did not significantly affect the users' challenge appraisal. Further research should consider the novelty effect and use larger sample sizes. We contribute to a broader understanding of the cognitive appraisal process in IS use research and provide insights into how gamification can support challenge appraisal and reduce threat appraisal.

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