# Preferred Gamification Elements in a Health Behavior Change Support System for Stress Management

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## Abstract

*Stress is a serious hazard to individuals. Health behavior change support systems (HBCSSs) may support individuals to modify their behaviors toward a healthy lifestyle. Previous studies have shown that HBCSSs for stress management can improve individual coping behavior but their success depends on the users' adoption and long-term use. Gamification elements (GEs) can contribute to continuous use by motivating their users, enabling sustained healthy stress coping behavior. With a mixed-methods approach, we identified suitable GEs through six interviews with users of a mobile coping assistant prototype. Based on those insights, we designed GE mockups and surveyed 204 participants using the best-worst-scaling method to examine the users' preferences. The results demonstrate that users mostly prefer feedback elements, such as scoreboards and progress bars in HBCSSs for stress management. Social interaction GEs score worst. Our interviews indicate that this could be due to privacy reasons.*

**Keywords:** Health Behavior Change Support Systems, Stress Coping, Gamification, User Preferences, Best-Worst-Scaling

## 1. Introduction

According to the World Health Organization, mental health issues and stress are increasingly common in many societies, both in professional and private life (World Health Organization, 2021). As a result of acute or chronic stress, people suffer from significant health problems such as psychological exhaustion and burnout, among others. To decrease stress effectively, coping strategies are important ways of mitigation for individuals. Yet, individuals often struggle to find effective coping strategies from a plethora of available options. Digital technologies may prove helpful in this regard. Facilitated by the widespread, powerful sensor technology in modern mobile devices, information and communication technologies (ICT) such as health behavior change support systems (HBCSSs) have grown popular. An HBCSS is defined as a health-related "socio-technical information system (IS) with psychological and behavioral outcomes designed to form, alter or reinforce attitudes, behaviors or an act of complying without using coercion or deception" (Oinas-Kukkonen, 2013, p. 1225). All HBCSSs are persuasive systems, i.e., they were created with the intent of influencing user behavior. Various studies have already examined the potential of ICTs (in particular HBCSS) to sense stress and support people in developing appropriate stress avoidance or coping strategies (e.g., Adam et al., 2017; Reimer et al., 2020; Schmidt et al., 2022). For example, Reimer et al. (2020) and Adam et al. (2017) suggest that IS should recommend targeted behavioral and emotional coping strategies for dealing with stress (e.g., relaxation) or automatically carry out technological activities to avoid stressful situations (e.g., switch off notifications). Further, Adam et al. (2017) and Schmidt et al. (2022) developed a vision for a mobile coping assistant that provides individualized, targeted,

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automated stress coping support by promoting long-term behavior change and thus assisting in coping with stress. Yet, the success of such solutions depends on the user's adoption and long-term use of the technologies. Therefore, Schmidt et al. (2022) and Christmann et al. (2018) recommend including gamification elements (GEs) to promote long-term behavior change. This is because GEs may help motivate users to use the HBCSS continuously. The authors call for future research to investigate which GEs are best in the realm of stress management to inspire behavioral change (e.g., Schmidt et al., 2022). This is congruent with prior gamification research that emphasizes the relevance of exploring GEs in the context of stress management to motivate app users and thus to contribute to healthy coping behavior (Christmann et al., 2018; Hoffmann et al., 2017; Nacke & Deterding, 2017). The study by Hoffmann et al. (2017) suggests that the use of gamification in the stress context is not yet widespread.

Instead of including a "one-size-fits-all" gamification solution into HBCSSs for stress management, it is crucial for user acceptance to meet the users' preferences of GEs. This is because by meeting users' preferences, user satisfaction can be supported, which positively influences continuous technology use (Bhattacherjee, 2001; Thong et al., 2006). Such continuous use of HBCSSs for stress management (for example through mobile coping assistants) is crucial as it may lead to long-term healthy coping behaviors and thus positive stress management outcomes. We address this research gap in this paper by examining users' preferences for GEs in the context of stress management to promote long-term app use. We aim to answer the following research question: *Which GEs are most preferred to motivate the continuous use of HBCSSs for stress management?*

To answer our research question, we use a mixed-methods approach. First, we aim at understanding the users' needs, through six qualitative interviews with users of an HBCSS for stress management and identified six suitable GEs. Second, we classify the identified GEs based on the extended taxonomy of GEs and their accompanying definitions (Hoffmann et al., 2017). Third, we use insights from the interviews to design suitable GEs for our context. Fourth, we conduct a survey using the best-worst-scaling (BWS) method to examine the users' preferences of GEs in an HBCSSs for stress management.

# 2. Theoretical Background

## 2.1. Foundations and Stressors

Human stress has been studied extensively across many fields. The Transactional Model of Stress (Lazarus & Folkman, 1984) is widely utilized in that regard. According to it, stress is defined as a two-way process that reflects the interaction between specific situations and the individual's resources (e.g., knowledge). The process is triggered by internal psychological circumstances (e.g., lack of sleep) or the environment (e.g., a low ambient temperature) in the individual's environment. During the initial encounter, the person assesses whether the specific situation triggers a stress reaction (i.e., acts as a stressor) and whether the available resources are sufficient to cope with the stressor. An individual mismatch of resources to cope with the stressor may manifest as physiological (e.g., increased heart rate), emotional (e.g., anxiety), cognitive (e.g., cognitive irritation), or behavioral (e.g., fatigue), short-term symptoms (Ayyagari et al., 2011; Lazarus & Folkman, 1984). Frequent exposure to stress may have long-term negative consequences, such as a deterioration of physical or mental health (Ayyagari et al., 2011; Lazarus & Folkman, 1984).

Stressful situations can occur in different contexts. For example, major life events (e.g., divorce) and daily problems (e.g., losing items) are both considered stressors in the literature (Kanner et al., 1981). Further, IS research has emphasized the use of ICTs as a major cause of stress in modern society – a phenomenon known as *technostress* (Tarafdar et al., 2007). *Technostress* is defined as "stress that individuals experience due to their use of IS" (Tarafdar et al., 2019, p. 6). There are many examples of stressors related to the use of ICTs: e.g., interruptions caused by ICTs (Galluch et al., 2015), unreliability of ICTs (Adam et al., 2017), or a perceived overload with information, communication, or tasks mediated through ICTs (Ragu-Nathan et al., 2008; Tarafdar et al., 2007).

## 2.2. Stress Coping Assistant

When confronted with stressors, people can use a variety of coping strategies to alleviate stress-related symptoms or to address the underlying problem. Coping is defined "as constantly changing cognitive and behavioral efforts to manage specific external and/or internal situations that are assessed as taxing or exceeding the resources of the person" (Lazarus & Folkman, 1984, 1984). Individual traits (e.g., age) and

contextual variables (e.g., stressor(s)) influence the choice of various coping strategies (Schmidt et al., 2021).

To assist individuals in coping with stress, digital assistants, such as HBCSSs, have gained popularity. Such technologies are enabled by the widespread use of powerful sensor technology in modern mobile devices. HBCSSs are persuasive systems, which aim to intentionally shape or modify attitudes and behaviors related to a healthy lifestyle voluntarily (Kankanhalli et al., 2021; Oinas-Kukkonen, 2013). Various studies have already examined the potential of HBCSSs to sense stress and support people in developing appropriate stress avoidance or coping strategies by promoting long-term behavior change (Adam et al., 2017; Schmidt et al., 2022). Most approaches do so by trying to increase stress awareness and stress coping expertise. While these methods have shown to be beneficial, the available technological solutions have yet to fully explore the possibilities of mobile coping support (Schmidt et al., 2022). The successful prototypes by Schmidt et al. (2022) and Reimer et al. (2020) demonstrate the general feasibility of creating HBCSSs for stress coping and substantiate that the proposed design qualifies to produce effective mobile coping assistants. However, user compliance and intensity of use are often low, which does have a negative influence on behavior change. Therefore, gamification offers a promising approach to motivate the continuous use of HBCSSs for stress management (Christmann et al., 2018).

### 2.3. Gamification in the Context of Stress

Gamification is "the use of game design elements in non-game context" (Deterding et al., 2011, p. 9). Different categorizations of GEs exist (Hamari & Koivisto, 2014; Thiebes et al., 2014). Examples of GEs include, among others, feedback elements like *progress bars*, (internal or external) rewards like *points and financial incentives*, or (social) interaction elements like an *agent*. *Progress bars* allow users to see their progress and provide information on whether they are getting closer to their goals (Passos et al., 2011). *Points* are internal rewards for completing a task or achieving a goal (Hiltbrand & Burke, 2011)). In contrast, external rewards refer to cash rewards, for example, in the form of coupons (Luhanga et al., 2016). To support long-term behavior change, prior research recommends the avoidance of external rewards (Nicholson, 2015).

Hoffmann et al. (2017) constructed an extended taxonomy of GEs with their accompanying definitions for stress management apps. Currently, the use of gamification in the stress context is not widespread (Helf & Hlavacs, 2016), with 68 % of the stress management apps not using GEs at all (Hoffmann et al., 2017). Of the apps using GEs, performance-related GEs such as feedback (e.g., *scoreboards, progress bars*, or *visual feedback)* are most used in existing apps, followed by parallel communication systems (i.e., interaction with other players within the application through text or email, e.g., in the form of social media platforms). Some apps reviewed in the study made use of digital rewards (e.g., *points*, *badges*), levels, or leaderboards.

Given the positive impact of gamification on motivation and engagement, GEs can be used to promote the use of HBCSSs (Hamari, 2013; Hoffmann et al., 2017). Gamification can increase motivation through the fulfillment of the three basic needs for: competence (also known as mastery), autonomy, and social relatedness (Ryan & Deci, 2000). For example, the GE *social interaction* fulfills the need for social relatedness, or the GE *progress bar* addresses the need for competence (Sailer et al., 2017). By influencing the three basic needs, gamification can support motivation. Motivation is in turn increases the intention to use an app (Guo & Barnes, 2011), which positively influences behavior change – in the case of HBCSSs, to improve coping behavior.

Notwithstanding the app designers' reluctance about the potential use of gamification in stress management apps, little is known about how GEs are interpreted in this context (Schmidt et al., 2022). Yet, previous research has indicated that not all GEs appear suitable for every context (Schmidt-Kraepelin et al., 2019). Thus, Schmidt et al. (2022) and Hoffmann et al. (2017) call for future research to investigate which GEs are best in the realm of HBCSSs for stress management. Users' preferences for GEs have been analyzed in different contexts, e.g., nutrition (M. Berger & Jung, 2021), sports (Schmidt-Kraepelin et al., 2019), and learning management systems (Schöbel & Söllner, 2016). Comparing these contexts, differences in users' preferences were found. This leads to the conclusion that users' GE preferences in the context of HBCSSs for stress management should also be investigated to inform researchers and practitioners on how to effectively promote long-term app use.

## 3. Method

Our research strives to determine the most preferred GEs in HBCSSs for stress management to increase their use, and hence assist individuals in coping with stressful situations. For that, we conducted a mixed-methods study with a

developmental design (Venkatesh et al., 2013). We first interview six users of an HBCSS for a stress management mobile app prototype to understand their needs and collect insights on helpful GEs. Second, we classify the mentioned GEs from our interviews into the extended taxonomy of GEs for stress management apps proposed by Hoffmann et al. (2017). Next, we design six suitable GEs for our context based on the insights from the interviews. Lastly, we conduct a survey with 204 potential users to identify the most preferred GEs that can support long-term app use behaviors and thus may lead to positive stress management outcomes.

## 4. Qualitative App-Interviews

We interview six users of an HBCSS for stress management mobile app prototype (33% female, average age 25 years). Table 1 describes the participants with their age and gender.

**Table 1. Participants in the interview**

| ID | Age | Gender |
|---|---|---|
| 1 | 21 | male |
| 2 | 28 | male |
| 3 | 25 | male |
| 4 | 23 | female |
| 5 | 26 | male |
| 6 | 25 | female |

Based on sensor data and user input on perceived stress, the mobile app prototype infers the users current stress level and assesses what coping strategies individuals use for specific situations. The app also informs individuals about different available families of coping strategies and shows descriptive sensor data that helps individuals identify potential digital stressors. The semi-structured interviews with its users consist of questions concerning appropriate GEs for such apps and their potential design. We ask questions like "What gamification elements would you like to see in the app so that you use it regularly?" and "What gamification elements would you have liked to see in the app to increase usage?", "What should the app and the mentioned features have looked like to be appealing?". We analyze the interviews by coding the qualitative data and building code categories. The responses of the users surveyed suggest ideas for preferred GEs.

We exemplarily present the interview results and classify the suggested GEs into the categories by Hoffmann et al. (2017). For example, interviewee 4 points out "Reflecting on my daily routine is very helpful. [It gets me] going quite well in that I can […] reflect: was it stressful, or was it not stressful [over time]? That would be interesting!" (GE feedback: e.g., *scoreboard*). Further, the interviewee 3 reflects "What I would have liked even more would have been to [...] receive feedback on how my stress level changed and how well [the intervention] worked while I dealt with these stressful situations." (GE feedback: e.g., *progress bar*). Interviewees 1 and 6 also state that app developers could increase the intensity of stress management app use by "rewarding the use of the app". Interviewee 1 elaborates "What plays a role is when the intensity in which I used the app gets acknowledged. In the sense of: 'dear [user], you have spent a lot of time using this app […]" (GE internal rewards: e.g., *points* or *badges*). Interviewee 2 suggests "[...] that you somehow have the option to [perhaps] get in touch with people who are in a similar situation or who are struggling with similar problems." (GE social interaction: e.g., *communication*). Also, interviewee 2 points out the following: "So I think what could be helpful at the beginning would be a kind of short intro in which it is said [how the app is structured]. [...] that this is done in an introductory, visual way. [And] that there is a guidance throughout." (GE social interaction: e.g., *agent*). As a result, we find that the GEs considered suitable by our interviewees fall into the broader categories of *feedback, (internal) rewards,* and *social interaction* (Table 2).

## 5. Design of GEs for Best-Worst-Scaling

To stimulate the imagination of the potential users during the quantitative part of our analysis, we design mockups of the GEs. For that, we ask the app prototype users for concrete design input to then create an exemplary screenshot for each GE. The GE *progress bar* shows the weekly stress-level history indicating that the stress level is decreasing, increasing, or stable. The second GE of the category of feedback, namely *scoreboard*, shows the stress level for self-reflection over the course of the day. The GE of the (internal) rewards category is simulated when coping with stressful situations (e.g., when successfully applying a coping strategy) by receiving a *badge*. The second GE of the reward category, *points*, indicates the points earned (e.g., +20 points for a social media break during lunch). The GE *communication* displays notifications of the users community (e.g., "Marie shared five tips for digital detox with you") and enables to share experiences. Lastly, the GE *agent* "Relaxa" presents the categories of the app as a companion and is based on user suggestions. Figure 1 shows screenshots of the six designed GEs.

**Table 2. Analyzed GEs in this study**

| GE category | GE | Definition |
|---|---|---|
| Feed-back | Score-board | *Scoreboard* displays the score of a match or game (Adaji & Vassileva, 2017). |
| | Progress bar | With *progress bars* user can track their progress and receive feedback about whether they have come closer to their goal (V. Berger & Schrader, 2016). |
| (Internal) Rewards | Badges | *Badges* are visual rewards for completing specific tasks that are not part of the core activity (Hamari, 2013). |
| | Points | *Points* are a reward for the successful completion of a task or goal. A numerical value is added to the individual total point score (Hiltbrand & Burke, 2011). |
| Social Inter-action | Com-muni-cation | *Communication* and social interaction exist when a community of players can communicate and support each other (Sardi et al., 2017). |
| | Agent | An *agent* is a virtual character that does not represent oneself and provides instructions or support (Hoffmann et al., 2017). |

## 6. Survey-based Best-Worst-Scaling

To analyze users' preferences, different methods (e.g., ranking, or conjoint analysis) exist. BWS is a type of conjoint analysis that was first used in healthcare by Szeinbach et al. (1998). In this method, the participant chooses two objects from a changing set of three or more objects – one that they prefer the most and one that they dislike the most (Lansing et al., 2012). When compared to similar preference elicitation methods or simple rankings, the BWS approach has several advantages for our research. First, each object is examined separately, forcing participants to weigh the pros and cons of the objects (Louviere et al., 2013). Second, participants do not need to match their choices to the full range of variation in the set (here: 3 objects) or remember previous answers (Burton et al., 2019). Also, the method is scale-independent, so it is free of potential order effects (Schmidt-Kraepelin et al., 2019).

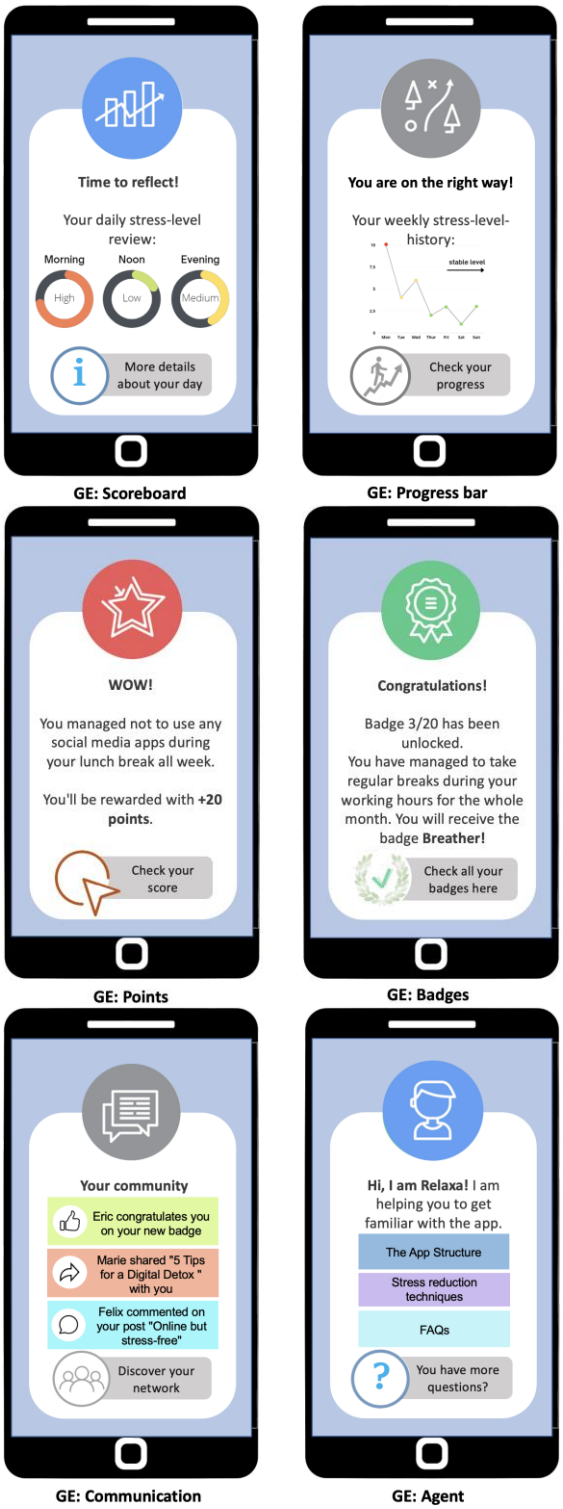


**Figure 1. Screenshots of the six GEs**

The objects in the BWS method represent the six different GEs in this study. By selecting the GEs in each set, the most and least preferred GEs are determined. We created 10 different blocks based on Orme's (2005) recommendation, with each block consisting of three different GEs.

As a result, each GE appears exactly five times in five different question blocks, and the same combination of objects do not appear multiple times in a question block (Table 3). We used an online survey to collect anonymized data for the BWS method. The online survey consists of an introduction and two question parts. The participants are first introduced to the topics of stress in general and technostress specifically. Second, we explain the rise of stress management apps and their ability to improve stress coping. Third, the six different GEs are explained (c.f., Table 2). Subsequently, the BWS procedure starts. To ensure that participants carefully fill in the survey, we include a control question asking to select the correct answer for "What was the survey about?" (stress coping app or gaming app). Finally, we query demographic characteristics. In total, the survey takes approximately 10 minutes to complete. The survey participants are 204 students or acquaintances of them (94 men, 109 women and one diverse) recruited via a German university, friends, and family. The average age of the participants is 30.

To analyze the data, based on Orme (2005), we calculate a counting analysis to determine rank positions. For the counting analysis, the difference in frequencies that an element was chosen as either best or least preferred are calculated. This number is then divided by the times it appeared in our set (five) and divided by the number of total participants (in our case 204) (Finn & Louviere, 1992). The counting analysis yields a standardized mean value (std. mean). The std. means show the participants' average preference for the GE and takes values between -1 and 1. Participants favored an element with a greater value (Lansing et al., 2012; Schmidt-Kraepelin et al., 2019).

## 7. User Preferences of GEs in HBCSSs for Stress Management

The results of the counting analysis (see Table 4) demonstrate that the *scoreboard* and *progress bar* are by far the most preferred GEs in a HBCSS for stress management mobile app, with standard mean values ranging from 0.373 to 0.413. *Points* and *badges* follow. With a more considerable distance behind and least preferred by the participants, the *communication and agent* place five and six. The number of times an element was selected as the best is listed in the "Best" column, while the number of times an element was selected as the least desired is listed in the "Worst" column of Table 4.

**Table 4. Counting analysis of BWS**

| GE | BEST | WORST | Std. mean | Rank-ing |
|---|---|---|---|---|
| Score board | 554 | 133 | 0.413 | 1 |
| Progress bar | 556 | 176 | 0.373 | 2 |
| Points | 360 | 324 | 0.035 | 3 |
| Badges | 290 | 268 | 0.022 | 4 |
| Communi-cation | 167 | 551 | -0.376 | 5 |
| Agent | 113 | 588 | -0.466 | 6 |

Males and females have the same preference for the GE, according to a separate analysis of the data. Men and women ranked all items in the same order of preference. Despite same order of preferences, the data show that men find feedback-based GEs (*scoreboard* 292 and *progress bar* 281) slightly better than women (*scoreboard* 260 and *progress bar* 275). And women rate rewards (*points* 203 and *badges* 172) more positively than men (*points* 153 and *badges* 115).

**Table 3. Choice sets for BWS approach**

| GE | Choice Set ID | | | | | | | | | | Total Appearance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| Badges | | ✕ | ✕ | ✕ | | | | ✕ | | ✕ | 5 |
| Points | ✕ | | | ✕ | ✕ | | ✕ | ✕ | | | 5 |
| Communi-cation | | | ✕ | | ✕ | ✕ | | ✕ | ✕ | | 5 |
| Progress bar | | ✕ | | ✕ | | ✕ | ✕ | | ✕ | | 5 |
| Score board | ✕ | | ✕ | | | ✕ | ✕ | | | ✕ | 5 |
| Agent | ✕ | ✕ | | | ✕ | | | | ✕ | ✕ | 5 |

## 8. Discussion

Existing studies on HBCSSs for stress management analyze and mention the potential of gamification concepts (Schmidt et al., 2022). One of the key challenges is continuous app usage to enable long-term behavior change (Guo & Barnes, 2011). While GEs are helpful in this regard, existing studies provide little insight into users' preferences for single GEs. In this study, we answer the research question of which GEs are preferred and thus well suited to motivate the continuous use of HBCSSs for stress management. Using a mixed-method approach, we were able to identify six suitable GEs of HBCSSs for stress management with the help of the interviews and, in a second step, generalize these results using a quantitative survey. The quantitative and qualitative results should be considered complementary.

Our results indicate that users prefer feedback elements in HBCSSs for stress management (*scoreboard* and *progress bar*). Feedback elements can improve the efficacy of a stress intervention by providing information about daily stress levels and assisting the user in making decisions (DiClemente et al., 2001). These findings also go along with insights on users' preferences in HBCSSs in other contexts (e.g., healthy nutrition or physical activity) (M. Berger & Jung, 2021; Schmidt-Kraepelin et al., 2019). *Progress bar* is the most preferred GE in HBCSSs to support healthy nutrition (M. Berger & Jung, 2021) and physical activity (Schmidt-Kraepelin et al., 2019). This emphasizes the overall need for feedback in HBCSSs among all contexts concerning the users' health status. Users of HBCSSs for stress management are also interested in transparency concerning their stress level (*scoreboard*) and its development over time (*progress bar*).

These findings strengthen and extend the architecture of HBCSS for stress management developed by Schmidt et al. (2022). This architecture involves a feedback component after the app has detected heightened stress levels. Yet, the authors of the architecture pose the question of how this feedback should be designed (Schmidt et al., 2022). Our findings indicate that current app users find *scoreboards* (first) and *progress bars* (second) most suitable. The GEs of the feedback category were mentioned more often than average in the qualitative app interviews. The users interviewed emphasized that feedback GEs would be helpful for intensive self-reflection. This, in turn, has a positive effect on motivation. Furthermore, they mentioned that feedback GEs make progress more clearly recognizable and lead to better self-assessment.

Interestingly, the standard mean of the elements *points* and *badges* are close to zero, indicating ambiguous views on these GEs (i.e., almost the same counts of "Best" as "Worst"). Apparently, one group of users prefers reward GEs including *points* or *badges*, while another group does not prefer these elements. In our study, women are slightly more enthusiastic about collecting points and badges than men. These differences may lay in different personality traits (Jia et al., 2016), which need further research (i.e., a gender-specific analysis). Also, different types of stressors (i.e., stress contributors like work overload and interruptions due to ICTs) might influence the preferences for reward GEs. This indicates that such GEs might be implemented as optional features. In that case, users can decide if they would like to collect *points* or achieve *badges* when they have successfully applied a coping measure or have kept the stress level low for a certain period. The contradictory views of *points* can also be found in the studies concerning HBCSSs for nutrition and physical activity. While in the context of physical activity, *points* are highly preferred, users reject *points* in the context of nutrition (M. Berger & Jung, 2021; Schmidt-Kraepelin et al., 2019). The result of our study indicates that users' preferences for gamification in HBCSSs varies greatly between contexts.

*Communication* and *agent* score worst, indicating that these GEs are not preferred by users in HBCSSs for stress management. Therefore, most users are not interested in collaboration while dealing with stress. This goes along with the findings concerning healthy nutrition and physical activity. Thus, our results emphasize the similarity in HBCSSs regarding rejection of interactive GEs. The low score for *communication* and *social interaction* in all HBCSS contexts could be due to privacy and data security awareness, especially regarding sensitive health data. This assumption is supported by several users expressing privacy concerns in the qualitative app interviews. However, they would appreciate the exchange with people in a similar situation. Further, in a study by Hoffmann et al. (2017), most existing apps did not include such social community aspects either. Nevertheless, collaboration and communication can be essential means of social support, especially in the context of stress (Hoffmann et al., 2017).

Overall, users of gamified HBCSSs for stress management prefer GEs that offer transparency into their progress and current stress levels. Similar to the context of nutrition, users do not prefer collecting *points* or *badges*, which might be because nutrition and stress are perceived more as private and individual topics that do not profit from the competition as much as physical activity. Hence, users primarily prefer GEs

that support them in their individual processes without collaboration (*communication*) or competition (*points*, *badges*).

### 8.1. Implications

Our work contributes to knowledge about gamification in HBCSSs for stress management by identifying users' preferences. It has multiple theoretical implications and thus contributes to the existing body of knowledge in the field:

(1) We find that the GEs most preferred by users in HBCSSs for stress management are GEs in the form of feedback elements (*scoreboard* and *progress bar*). These feedback elements should therefore be considered when designing HBCSSs for stress management (e.g., mobile coping assistants).

(2) We assume that different user groups exist concerning their preferences for reward GEs like *points* or *badges*. Apparently, one group of users prefer reward GEs while another group does not.

(3) We found that social interaction is not necessarily needed in apps related to stress management. This finding is in line with the research in the context of HBCSSs for healthy nutrition or physical activity.

(4) Synthesis with existing studies from different areas of gamification application showed that there are context-related differences. In the context of stress as well as nutrition, users prefer *points* less than in the context of sports. We conclude that the topics of nutrition and stress might be more related to each other due to their personal and individual nature and less competition in form of collecting *points* is needed.

Our results also provide practical implications which demonstrate their broad practical applicability in the field of stress management. Stress-related issues are a severe concern leading to personal suffering and rising costs of the healthcare system. First, the individual benefits from positively influenced long-term behavior changes through a stress management app designed in accordance with their preferences. Consequently, users face fewer stress-related symptoms in their daily lives through continuous use of such an app. We inform design decisions through our study and assist app developers in providing adequate GEs for this context. Based on our results, app designers can focus on the most popular GEs identified to drive long-term healthy coping behaviors and thus lead to positive stress management outcomes.

### 8.2. Limitations and Future Research

As in every study, several aspects of this article have limitations and may require more investigation. First, while our study provides valuable insights about users' preferences, the results do not imply the GE's effectiveness. Catering to the users' preferences is likely to increase acceptance, which is the first and an important step towards continuous use of an app. Yet, independent evaluations of the effectiveness of the most important elements in ensuring continuous use and long-term behavior change are also essential. Second, the study was restricted to the six GEs discussed in our qualitative interviews with users of HBCSSs prototype. It is possible that more interviews would have led to the consideration of more elements. Yet, we interviewed only six users of a stress management mobile app prototype. This small sample size is certainly a limitation of our study. Yet, it was very valuable for our interviews that the interviewees had previously interacted with such a prototype. All participants used the app intensively and could provide highly qualified answers to the interview questions. Unfortunately, the prototype had only been tested with a small number of users, and thus, the pool of interviewees was limited. Third, the survey's design has certain shortcomings. Participants in the survey were given one design option for each of the six elements based on a screenshot. We designed these screenshots in an equally appealing way to ensure as much comparability as possible. Yet, it is still possible that the survey participants' decision was influenced in part by whether they liked the design. Given that an element in an HBCSS app can be assumed to have an infinite number of optical variants, it would be good to offer numerous design variations of an element in future research. Fourth, previous experiences with GEs, behavioral characteristics such as app usage habits, or information regarding the personal goal and motivation stage were not taken into account when the findings were evaluated. Previous experience with some GEs influences the preferences of survey participants towards GEs, as has been discovered in a comparable study (Schmidt-Kraepelin et al., 2019). Control variables such as behavior variables related to app usage, including previous experience with GEs and the personal objective, as well as motivational mood should be queried and used in the future.

## 9. Conclusion

In this research, we establish a link between the need for stress coping and the potential of gamified HBCSS for stress management by identifying design elements that facilitate its use. Using a mixed-methods approach, we first identify adequate GEs in this context and inform their design through user interviews. In our quantitative analysis, a BWS analysis reveals that the most preferred GEs in stress

management apps are feedback elements (*scoreboard* and *progress bar*). Social interaction GEs are least preferred, potentially due to stress being a very private subject. As this study demonstrates, users' preferences vary based on contexts. While our study provides valuable insights into users' preferences of GEs, it does not allow for conclusions regarding their effectiveness in promoting continuous use of HBCSSs. Thus, we encourage further research into the matter for further insights that allow users to deal with stress in a healthier or more long-term manner.

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