Key Design Considerations for Digital Work Stress Interventions: Content Analysis & Narrative Synthesis

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Abstract

Background: Work-related stress is a pervasive issue with significant implications for individual well-being, organizational productivity, and societal costs. Preventive interventions are a promising avenue for mitigating the negative health consequences of stress. More specifically, Digital Behavior Change Interventions (DBCIs) offer a scalable means of support that can be made widely available. However, evidence-based design guidelines specifically tailored for DBCIs targeting work stress are needed to support development efforts and enhance intervention quality.

Objective: The primary aim was to identify key features in digital interventions for work stress to develop practical guidelines for intervention development.

Methods: A deductive content analysis identified key features in peer-reviewed mental health interventions to inform recommended guidelines. Interventions were included for analysis based on being digital interventions targeting mental health for an overall healthy population. Interventions with better documentation (e.g., more detailed Methods sections describing the intervention) were prioritized. Selected interventions were subsequently analyzed by coding and mapping features using the Behavior Change Technique (BCT) Taxonomy and the Persuasive System Design (PSD) framework. A narrative synthesis approach was used to integrate and interpret findings across the reviewed interventions.

Results: Ten interventions were included for analysis. The analysis revealed that many features in the reviewed applications could be coded according to the BCT taxonomy and PSD framework. Self-monitoring, prompting, and personalization features were the most common while features related to goal setting, rewards and social support were less frequently observed. Some intervention features integrated several BCTs and PSD principles within the same feature.

Conclusions: We propose key design guidelines for developing more effective DBCIs for work stress. These include: (1) continuing to leverage core synergistic features such as self-monitoring, prompting, and personalization; (2) including underutilized features like goal setting and reward functions which can be smoothly integrated within common intervention formats, (3) embedding scalable social support, for instance by connecting co-workers with each other, (4) developing features that activate several behavioral mechanisms. Adhering to these guidelines may help optimize DBCIs for improved user engagement and intervention outcomes.

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Key Design Considerations for Digital Work Stress Interventions: Content Analysis & Narrative Synthesis

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Abstract:

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Objective: The primary aim was to identify key features in digital interventions for work stress and develop practical guidelines for intervention development.

Methods: A deductive content analysis identified features in peer-reviewed mental health interventions to inform recommended guidelines. A search was conducted to find digital interventions targeting stress-related health outcomes that had been studied in a working population. Interventions with better documentation (e.g., more detailed Methods sections describing the intervention) were prioritized. Selected interventions were subsequently analyzed by

coding and mapping features using the Behavior Change Technique (BCT) Taxonomy and the Persuasive System Design (PSD) model. A narrative synthesis approach was used to integrate and interpret findings across the reviewed interventions.

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Conclusion: We propose key design guidelines for developing more effective DBCIs for work stress. These include: (1) continuing to leverage core synergistic features such as self-monitoring, prompting, and personalization; (2) including underutilized features like goal setting and reward functions which can be smoothly integrated within common intervention formats, (3) embedding scalable social support, for instance by connecting co-workers with each other, (4) developing features that activate several behavioral mechanisms. Adhering to these guidelines may help optimize DBCIs for improved user engagement and intervention outcomes.

Keywords: Digital behavior change intervention, mHealth, behavior change, persuasive technology, mental health, work stress

Introduction

Preventive Health through Digital Behavior Change Interventions

Preventive health behaviors and daily habits play a crucial role in mitigating the development of physical and mental health conditions [1]. Establishing and maintaining healthy routines can significantly reduce disease burden while enhancing overall wellbeing [2, 3]. Unfortunately, developing a consistent routine of healthy behaviors is notoriously difficult, with individuals often struggling to translate intentions into sustained practice. For this reason, programs designed to promote health behaviors seek to address this intention-behavior gap by providing evidence-based strategies to support individuals in adopting healthier habits [4, 5].

Digital Behavior Change Interventions (DBCI) – structured programs leveraging digital technology to facilitate behavior change - have emerged as particularly promising tools in preventive health promotion [6]. The digital medium offers unique advantages with regards to accessibility and scalability, providing the opportunity of making these tools widely available to people in a range of different contexts [7]. Evidence indicates that DBCI have been found effective on several behavioral and health outcomes, including physical activity, sleep, and mental well-being [8-10].

One area where DBCIs may prove beneficial is in the context of work-related stress. Work stress is prevalent in the working population and a risk factor for many health problems, including burnout, depression, and cardiovascular disease [11, 12]. These conditions not only negatively affect individuals but may also have detrimental effects on organizations, leading to increased sick leave, higher turnover rates, and reduced productivity [13]. Work-related stress thus incurs substantial costs both in terms of personal suffering and its broader impact on organizations and society at large.

DBCI that target stress management are well-suited to provide accessible and scalable support to workers and have indeed been found effective in this context [14-16]. Various stress management techniques - such as relaxation, mindfulness, and physical activity - can alleviate short-term stress reactions and therefore decrease the risk of developing more serious health problems [17-19]. Interventions that successfully improve stress management among workers may thus decrease stress-related health issues in the working population.

Designing Effective DBCI through Persuasive Technology

Designing effective DBCIs is inherently complex as it requires the integration of multiple research

domains into a coherent structure. Firstly, a robust foundation of behavior change theory and practice is essential to increase the likelihood of the intervention inducing the desired behavior change [20]. In addition, it is important to take advantage of the digital medium itself by designing it in ways that are aligned with and support these behavior change processes [21, 22].

One way of incorporating theory and evidence-based strategies for effecting behavior change is through employing the *Behavior Change Technique* (BCT) taxonomy [23]. This taxonomy offers a list of 93 BCTs – "smallest identifiable components that in themselves have the potential to change behavior" [24]. By summarizing such techniques in a common framework, it enables researchers and developers to use these in order to inspire, build, and replicate behavior change interventions.

While using the BCT taxonomy is a great tool for supporting behavior change processes, it is insufficient for informing how to design *digital* aspects of the intervention. BCTs target behavior change independently of how the intervention or techniques are implemented; whether it is a therapist, digital system, or anything else delivering the intervention. Thus, for best practice regarding how to implement these strategies in a digital tool, it is necessary to incorporate knowledge from research fields such as Human-Computer Interaction and User-Centered Design [25].

Emerging from Human-Computer Interaction research, *persuasive technology* refers to interactive systems designed to influence user attitude and behavior [26]. This research field explores how psychological principles can be applied within computer systems to shape how users think and act. Persuasive technology has been applied to influence behavior in several domains, such as environmental sustainability [27], education [28], the workplace [29], and health promotion [30].

As an extension of persuasive technology, Oinas-Kukkonen & Harjumaa [31] developed the Persuasive System Design (PSD) model. This model is used for developing and evaluating persuasive technologies by outlining specific design principles that impact the persuasive effect of the system. This structured approach has proven valuable - meta-analyses indicate that using PSD principles improves the quality of DBCIs as they are linked with better adherence and efficacy [32-35].

Persuasive health behavior change

There is potentially a fruitful integration between the BCT taxonomy and PSD framework that can serve to deepen our understanding of how to design effective digital interventions. Silva et al. [36] argue that since BCT is focused on strategies that can facilitate health behavior change at large, while PSD is focused on digital aspects of persuasion, combining these frameworks could be productive for developing DBCIs.

Recent research has begun to explore this integration. Almutairi et al. [37] linked BCTs with PSD principles to better understand how to increase patient engagement with mHealth for chronic diseases. Asbjørnsen et al. [38] employed both models to identify ways of increasing motivation and adherence within weight loss maintenance interventions. Wang et al. [39] even integrated these models into the same structure which "embed[s] behavioral theories, BCT taxonomy, and PSD principles into a holistic framework".

Towards Design Guidelines:

Alqahtani et al. [40] employed an interesting approach by identifying BCTs and PSD principles in digital mental health interventions, mapping key features to provide a set of recommendations for intervention development. Guidelines such as these are crucial for supporting developers and researchers in designing effective interventions. Given the complex nature of DBCIs, having a set of key principles to follow may improve intervention quality by summarizing evidence-based knowledge in an easily accessible format.

While guidelines have been created in various domains, to our knowledge, no such set of recommendations has been developed for work stress interventions. Additionally, the integration of

BCT and PSD frameworks in workplace interventions remains underexplored. Given that work stress is a prevalent problem affecting workers in a unique environment, research is necessary to understand how to develop DBCIs in this context.

Aim:

The primary aim of this article is to systematically map intervention features to develop evidence-based recommendations for designing digital work stress interventions.

Methods

Search strategy:

A search was made in September 2024 in the database WebOfScience to find relevant and empirically supported interventions. This approach was chosen to find interventions with an empirical foundation rather than interventions lacking scientific rigor and a solid evidence base. The following search terms were used divided into three conceptual blocks:

(1) intervention technology – DBCI, Digital behavior change intervention, digital intervention, mHealth, mobile health

(2) intervention type - stress, work stress, mental health, well-being

(3) type of outcome - engagement, efficacy, effectiveness, engagement, acceptability, feasibility.

The complete search string was: (DBCI OR Digital behavior change intervention OR digital intervention OR mHealth OR mobile health) AND (stress OR work stress OR mental health OR well-being) AND (engagement OR efficacy OR effectiveness OR acceptability OR feasibility). The search resulted in 7893 articles.

Screening and selection:

ASReview Lab, a software using machine learning to sort articles based on user input and preference, was used to screen for relevant interventions [41]. Inclusion was based on interventions that are (1) web and/or mobile-based, (2) support mental health and well-being, (3) intended for an adult population. Interventions were excluded if they were (1) not digital, (2) intended for people with mental disorders (e.g., clinical depression or schizophrenia), (3) had children or the elderly as target populations. Screening was terminated upon ASReview Lab only returning irrelevant records. The screening processes resulted in 102 articles selected as describing relevant interventions.

These articles were subsequently subject to a quality check by the first author by reviewing the Methods section and supplementary materials to ensure there were sufficient details regarding the intervention design and structure. Preference was given to interventions with articles describing its design in greater detail, interventions with better documentation, interventions studied in several articles, and interventions that could be accessed and tested. Additionally, preference was given to interventions targeting stress that had been studied in a working population though this was not a strict inclusion criterion.

Upon finding a suitable intervention, relevant articles studying the same intervention were searched for and included even though they were not originally part of the articles found through the main search. A total of 10 interventions, studied in 26 articles, were included.

Coding & Analysis

We conducted a deductive content analysis to systematically identify and categorize features in the reviewed interventions based on the BCT taxonomy and PSD model [23, 31, 42]. Through examining each intervention (i.e., a combination of reading the articles, supplementary materials, documentation, and testing interventions), the first author coded intervention features by mapping them to relevant BCT techniques and PSD principles. This methodological approach allowed us to capture both the underlying behavioral function (BCT) and digital implementation strategies (PSD) for each feature. The results from this analysis are presented in Table 1.

The BCT taxonomy consists of 93 behavior change techniques divided into 16 categories, while the PSD model consists of 28 principles equally divided into four categories. Due to the large number of BCTs, features were often coded according to their category rather than individual techniques. The BCT taxonomy and PSD model are available in supplementary materials.

Following the coding of intervention features, we employed a narrative synthesis approach to integrate and interpret findings across the reviewed interventions. Features that were coded with the same BCTs and/or PSD principles were grouped together to form distinct categories based on their shared theoretical underpinnings (as shown in Table 2). For instance, features such as mood rating scales and step counters both map onto self-monitoring constructs of these frameworks, and were thus grouped within the same category.

This grouping allowed us to identify common patterns across interventions and develop more generalizable insights. The frequency of these categories was calculated, providing an understanding of what is commonly used and highlighting potentially valuable approaches that may be underutilized. Through this interpretive process, we constructed a narrative including descriptive insights about existing work as well as recommended guidelines for future interventions.

Results

All interventions targeted stress-related health with nine interventions studied in an employee population. Table 1 shows all reviewed interventions, related studies, along with identified BCTs and PSDs.

Table 1

Analyzed interventions, related studies, and coded BCTs and PSD principles.

Intervention	Studies	Persuasive System Design principles	Behavior Change Techniques
Anchored Employs evidence-based therapeutic techniques such as mindfulness, behavioral activation, goal-setting, coping skills, and relaxation techniques for reducing stress and depression.	Collins et al. (2020) Pilot evaluation N = 81 Australia Deady et al. (2023) 2-arm parallel RCT N = 2112 Australia	Personalization Rehearsal Reminders Self-monitoring	Feedback & monitoring Goals & planning Shaping knowledge
DIARY Supports habit formation of daily self-reflection and recovery including behaviors such as mindfulness, physical activity, social support, detachment, and value-driven actions.	Kowalski et al. (2024) Mixed Methods (N = 1267) Sweden Kowalski et al. (2024) Pilot Evaluation (N = 16) Sweden Kowalski et al. (2024)	Cooperation Praise Reminders Rewards Self-monitoring Suggestion	Association Feedback & monitoring Repetition & substitution Reward & threat Social support

	Factorial experimental design (N = 283) Sweden		
Florescer The mobile app was designed to promote well-being and handle psychological stress using a variety of techniques. Recommended practices included meditation, breathing techniques, positive psychology principles, and relaxation.	Coelhoso et al. (2019) 2-arm RCT (N = 490) Brazil	Reminders Rewards Self-monitoring Suggestion	Association Feedback & monitoring Shaping knowledge
GET.ON Stress Modular intervention based on improving problem solving and emotion regulation. Applies important principles for health behavior change such as goal setting and action planning.	Heber et al. (2013) Study protocol of 2-arm RCT Heber et al. (2016) 2-arm RCT (N = 264) Germany Ebert et al. (2016) 2-arm RCT (N = 264) Germany Ebert et al. (2021) 2-arm RCT (N = 396) Germany	Reminders Self-monitoring Tailoring	Goals & planning Repetition & substitution Shaping knowledge Social support
iGo Persuasive mHealth app with the aim to motivate employees to increase their daily physical activity and social interaction in the workplace. It was developed using user-centered design principles. iGo is based on Self-Determination Theory and makes use of gamified elements such as goal setting and a leaderboard.	Haque et al. (2016) Usability study (N = 26) Finland Haque et al. (2017) User-centered design prototyping Qualitative interviews (N = 8) Finland Haque et al. (2018) Usability evaluation (N = 28) Finland Haque et al. (2019) Feasibility 2-arm RCT (N = 84) Finland	Comparison Competition Personalization Reminders Rewards Self-monitoring Suggestion	Association Goals & Planning Monitoring & feedback Reward & threat Social support
Keela Mental Resilience App Stress reduction and well-being app for users in a workplace setting. Based on cognitive behavioral therapy and mindfulness-based cognitive therapy. Implements lifestyle changes through measuring behavior and emotions as well as providing psychoeducation.	Weber et al. (2019) 2-arm RCT (N = 532) United Kingdom	Personalization Reminders Self-monitoring Suggestion	Feedback & monitoring Goals & planning Shaping knowledge
Smiling Mind	Flett et al. (2018) 3-arm RCT (N = 210)	Personalization Reminders	Shaping knowledge Goals & planning

Smartphone app developed by psychologists and researchers, offering various mindfulness practices. Aims to teach skills that promote mental wellbeing and develop healthy habits. Key aspects include mindful living, flexible thinking, and social connection.	New Zealand Barlett et al. (2022) 3-arm RCT (N = 211) Australia Russel & Smyth (2022) 2-arm RCT (N = 29)	Self-monitoring Suggestion	Feedback & monitoring Repetition & substitution
STAPP@Work Self-management app for stress management and well-being. Functions by monitoring stress levels and activity and teaching coping strategies. Makes use of ecological momentary assessments and a stress-signaling plan for visualizing stress patterns.	Demirel et al. (2024) Single-case experimental design N = 63 Netherlands	Personalization Reminders Self-monitoring Suggestion	Feedback & monitoring Shaping knowledge
Woebot Chatbot intended to help with mood management and tracking. Guides users through psychotherapeutic content delivered via text-based messages. Utilizes tools such as progress reflection, gratitude journaling, and emotion regulation skills.	Fitzpatrick et al. (2017) 2-arm RCT (N = 70) United States Durden et al. (2023) Exploratory 1-arm trial (N = 262) United States Hoffman et al. (2023) User engagement study (N = 256) United States Chiauzzi et al. (2024) Exploratory 1-arm trial (N = 262) United States	Praise Personalization Reminders Rewards Self-monitoring Social role Tailoring	Feedback & monitoring Goals & planning Shaping knowledge Social support
WorkGuru Modular intervention utilizing principles from cognitive behavioral therapy, positive psychology, problem solving, and positive psychology. It teaches mindfulness, coping skills, and flexible thinking.	Carolan et al. (2016) Study protocol of 3-arm RCT Carolan et al. (2017) Pilot 3-arm RCT (N = 84) United Kingdom Carolan & de Visser (2018) Qualitative interview study (N = 18) United Kingdom	Cooperation Personalization Self-monitoring	Shaping knowledge Feedback & monitoring Social support

Note – The descriptions of each intervention are paraphrased from the original author and developer descriptions.

The following section summarizes the identified feature categories, their related BCTs and PSD principles, as well as providing examples from the reviewed interventions.

Category - Self-monitoring

Self-monitoring refers to features allowing users to track relevant health and behavior-related measures. This relates to the BCT category *Feedback & monitoring* in which key aspects of the

behavior change process are monitored (e.g., behavior or outcome of behavior) and provided as feedback. It was implemented into digital format through the PSD principle *self-monitoring*, in which the system tracks user progress on intervention-related measures. Self-monitoring features were present in all (10/10) reviewed interventions.

Examples of self-monitoring features include the application *Florescer* [43] asking participants to rate their stress and well-being levels on a 100-point sliding scale before and after each intervention exercise. Self-monitoring is also possible without user input, as in the *iGo* application [44-47] which automatically registers step count through the smartphone's accelerometer sensor.

Self-monitored data was often provided as feedback as a way for users to track their own progress. As an example, *Stapp@Work* [48] includes a visual representation of reported stress levels to provide users with an overview of their emotional patterns. There are also more complex methods of providing feedback to users – *Anchored* [49, 50] includes a feature that calculates the risk of users developing common mental health disorders based on user input.

Category – Personalization

Personalization refers to the ability of the intervention to adapt (e.g., appearance or content) based on users' individual needs, preferences, interests etc. This may happen either by the user actively choosing desired content, or the system adapting itself based on user input. Personalization features were present in 7/10 of the reviewed interventions. It does not correspond to any BCT though it relates to the PSD principles *personalization* and *tailoring*, which are different ways in which a system provides distinct content to individual users.

Examples include *Smiling Mind* [51] containing a library of many different exercises from which the user can personalize their own routine. In the *Anchored* intervention [49, 50], users could select custom reminders for completing specific activities. The *Woebot* [52-55] application tailors responses in a chatbot using machine learning algorithms.

Category - Prompting

Prompting refers to features in which the system sends information at specific times to the user. This was present in 9/10 of the reviewed interventions. Prompting relates to the BCT category *Associations* and more specifically the technique *Prompt/Cue* - a BCT in which stimuli serve as behavioral triggers for prompting the desired behavior. For instance, placing medication on the kitchen counter provides an environmental cue prompting a person to take their medication. Prompting was implemented through the PSD principles *reminders* and *suggestions*, in which the system reminds users of their target behavior at specific time points.

Examples include the *DIARY* intervention [56-58] which sends daily push notifications in the evening prompting users to engage with intervention material, shaping a daily habit of self-reflection and recovery. Additionally, the *iGo* application makes the phone vibrate as a reminder for users to go for a walk and then vibrates again signaling that they completed their 10-minute walk.

Category - Social support

Social support refers to features that includes some kind of human interaction as part of the intervention. This was present in 5/10 of the reviewed interventions. These features relate to the BCT category *Social Support* in which a person receives help from others in changing behavior, for example by receiving practical advice or emotional support. PSD also has a social support category suggesting various ways of motivating users through leveraging social influence. In the reviewed interventions this was implemented through the principles comparison, competition, and cooperation.

Examples of social support include *GET.ON Stress* [59-62] that has an eCoach (professional psychologist or master psychology student) as part of the intervention providing users with

individualized feedback. *WorkGuru* [63-65] explores the possibility of more human interaction by developing an online discussion board for users where they can learn more and share their experiences. *iGo* application had leaderboards where users compared points with each other on step-count measures.

Category - Rewards

Rewards refers to features that deliver positive feedback to motivate the desired behavior change in the user. These were present in 4/10 (40%) of the reviewed interventions. Rewards relate to the BCT category *Rewards & Threat*, in which positive or negative reinforcement are used as methods to incentivize target behaviors. This was incorporated into digital format through the PSD principles *Rewards* and *Praise*, in which the system provides virtual rewards or encouragement to credit users for performing or making progress towards their target behaviors.

Examples include *DIARY* [56-68] providing a virtual "badge" to users upon completing intervention content during five consecutive days to motivate continued adherence. *iGo [*44-47] takes this idea further, making extensive use of rewards as a core feature of the intervention. A point system awards points to users based on step count which can then be seen on a "leaderboard" for comparison with other users.

Category - Goal setting

Goal setting refers to users setting explicit goals or commitments for the desired behavior change. These features were present in 5/10 of the reviewed interventions. Goal setting relates to the BCT category *Goals & Planning* which involves the person forming explicit intentions regarding what changes they want to see as a result of engaging with the intervention. It does not correspond to any PSD principle.

In *Keela Mental Resilience App* [66], users self-select specific goals (e.g., happiness, sleep, stress recovery) after which the intervention curates appropriate content to improve this particular outcome. *Smiling Mind* [51] works in a similar way, where users pick particular topics they want to develop and then receive content supporting this development.

Category - Psychoeducation

Psychoeducation refers to features that provide users with relevant information regarding health or the target behavior, e.g., intervention goals or specific instructions for how to perform exercises. This was present in 10/10 (100%) of the reviewed interventions. Psychoeducation relates to the BCT category *Shaping knowledge* which is about providing relevant information and education to people to influence their knowledge and beliefs. It does not map onto any PSD principle.

As an example, *Florescer [43]* includes classes that have an introductory theoretical portion followed by a 15-minute guided practice. *Keela mental resilience app* [66] offers users relevant research and expected benefits before instructing specific techniques. *Anchored* [49, 50] provides evidence-based techniques through both psychoeducational videos and mindfulness audio exercises.

Table 2 –
Shows features coded with the same BCTs and PSD principles grouped together into categories

Feature Category	Feature implementation examples
Self-monitoring Features allowing users to track relevant health and behavior-related measures	100-point slider scale for registering mood Automatic step counter Visual representation of stress levels Calculated risk of mental health problem Leaderboard showing progress Questionnaires Sleep tracking Smiley selection for registering mood Weekly summary from chatbot
Personalization Ability of the intervention to adapt based on users' individual needs, preferences, interests etc.	Personalized feedback from coach Personalized messages from chatbot Personalized coping strategies Choosing focus/goal of intervention Choose exercises from library Customize reminders
Prompting Features in which the system sends information at specific times to the user.	Reminder notifications for self-monitoring Notification as prompt for behavior Phone vibration as prompt for behavior Bot sending message to initiate contact
Goal setting Users setting goals or commitment for the desired behavior change	Choosing focus / target behavior of intervention Setting specific goals Being asked by bot about goals Encouraging commitment
Rewards Using virtual rewards or encouragement to motivate the desired behavior change in the user.	Virtual badges upon successful completion Leaderboard with point system Emojis and GIFs Messages with positive reinforcement
Social Support Features that include some kind of human interaction as part of the intervention	Online discussion board eCoach therapist Leaderboard for comparing points with other users Encouraging peer support among colleagues Virtual agent

Psychoeducation	Educational videos
Providing users with relevant information regarding health or the target behavior	Educational texts Links to relevant resources Guided practices (audio and video) Information on research and expected benefits

Discussion:

Main findings:

The reviewed interventions included several features that could be coded as BCTs and PSD principles and grouped together based on these frameworks. Some types of features were very common - self-monitoring, personalization, psychoeducation, prompting – while others were used less frequently - social support, goal setting, and rewards. By reviewing the evidence regarding these features we provide recommended guidelines for intervention development, presented in Table 3.

Prevalent features:

Self-monitoring features were present in all reviewed interventions. The prevalence of self-monitoring is corroborated by systematic reviews indicating that self-monitoring is indeed one of the most widely used features in digital mental health interventions [67, 68]. This diary style practice of observing and logging one's behavior and mood is common in therapeutic approaches such as cognitive-behavioral therapy and has been found effective for inducing behavior change [69-71]. Importantly, self-monitoring translates well to digital format and has consistently been found to be an effective behavior change strategy in digital interventions [72, 73].

An important aspect of self-monitoring is the associated feedback, some kind of representation of self-monitored data available to users. Feedback is thought to increase engagement with the interventions and may also provide important insights to users about their intervention progress [74]. The ability to observe how your mood changes over time or whether you are progressing towards your goals can be both motivating and insightful.

While self-monitoring is an effective behavior change strategy on its own, its positive effects may be further improved by combining it with other strategies [75]. In fact, a meta-analysis by Michie et al. [76] suggests that coupling self-monitoring with other behavior change techniques induced the strongest intervention effects of any BCTs.

In the reviewed interventions, self-monitoring was often combined with *prompting* features – sending information to users at specified time-points. Typically, the system would remind users to self-monitor which is helpful to ensure that users adhere to the intended intervention protocol. Reminders have been used in a wide range of settings to influence behavior, for example to increase attendance at health clinics [77], improve medication adherence [78], and increase engagement with a smoking cessation intervention [79].

Prompting not only reminds users about self-monitoring but can also be used to prompt other kinds of intervention content, such as engaging in a new behavior. This is related to the BCT "Prompt/Cue" in which reminders from the intervention serve as a cue directing users to the desired behavior change, supporting habit formation. This dynamic of using reminders as behavior prompts is especially explored in Just-In-Time Adaptive Interventions that provide reminders at very specific moments to support intervention goals, e.g., suggesting physical activity upon registering a user has been sedentary [80].

Self-monitoring and prompting were often associated with personalization features, such as the ability to choose reminder frequency or receiving tailored feedback based on self-monitored data. Tailored interventions have been shown to have improved outcomes relative to non-tailored

alternatives [81]. In a workplace context, Moe-Byrne et al. [82] found that tailored interventions can have positive effects on employee stress, depression, and anxiety. Lastly, systematic reviews indicate that personalization can increase user engagement which is an important aspect of DBCI [83, 84].

The combined use of self-monitoring, prompting, and personalization also maps on quite well to some therapeutic approaches, showcasing its potential for improving mental health. For example, in cognitive behavioral therapy it is common to use a diary to log relevant information, have some kind of reminder or accountability system to do homework, and receive personalized feedback from a therapist [85].

Underutilized features:

Given the prevalence of these self-monitoring, prompting, and personalization features and how they work together in therapeutic modalities, it is surprising that features implementing goal setting and rewards are less common in the reviewed interventions. Goal setting is a key aspect of several behavior change theories and treatment plans, where a person starts by setting explicit goals with an intended action plan to get there. In the context of digital interventions, goal setting has been associated with improvements in user engagement and health outcomes [86, 87]. Goal setting can also simplify the personalization of interventions as the intervention can curate material more directly related to the chosen goals.

Another underutilized function in the reviewed interventions is rewards. Rewards are closely linked with behavior change and habit formation through positive reinforcement processes increasing the likelihood that a behavior will be repeated in the future [88, 89]. In digital interventions, Szinay et al. [83] suggest that rewards have a positive effect on uptake and adherence. Additionally, gamified interventions (that inherently make use of rewards) have been found to improve outcomes relative to non-gamified interventions [90 -92].

Goal setting and rewards naturally complement and enhance self-monitoring, prompting, and personalization features. When users set personalized goals (e.g., walking 10,000 steps daily), self-monitored data can track progress towards this specific goal and issue relevant prompts (e.g., "Time for your midday walk to meet your step goal!"). This creates a clear pathway: reminders prompt goal-directed actions where self-monitored progress is reinforced with rewards. Integrating goal setting and rewards in this way offers a simple and useful method for improving DBCI within already commonly employed intervention structures.

Scalable Social Support:

Another underutilized feature type is social support, present in 50% of the reviewed interventions. Social support may be especially important in the case of stress management interventions since it is known to buffer against the negative effects of stress [93, 94]. Indeed, studies indicate that social support plays an important role in preventing burnout among nurses [95, 96] with interventions targeting workplace social support showing promising effects on mental health [97, 98].

Most commonly in the reviewed interventions, social support is implemented through guided interventions that are supported by a therapist or other facilitator. Guided interventions consistently show higher adherence rates and intervention outcomes compared with self-guided interventions without human involvement [99 – 101]. As a caveat, the evidence in favor of guided interventions improving outcomes is mixed and the interaction between guidance, adherence, and outcomes is complex [102]. Considering the overall evidence, however, the integration of guidance in DBCIs is likely to improve intervention quality.

While guidance in interventions is a positive addition, it also comes with added costs and implementation efforts. Importantly, this can compromise the desired advantages of using a digital format, such as scalability and accessibility. If a motivation for developing DBCIs is to create standardized programs that are cost-effective and widely available, integrating professional support

as part of the intervention is counter-productive to this end.

There may, however, be more resource-effective ways of incorporating social support that do not negatively impact the advantages of the digital medium. Digital peer support, such as having shared forums or messaging systems between users, may contribute to improving interventions [103, 104]. Especially in a workplace setting, peer-to-peer support may be possible to implement by having the intervention encourage connection among co-workers and teach basic support skills [105]. This could potentially lead to a "carry-over" effect in which co-workers not taking part in the intervention also receive some benefits from increased social support in the workplace.

Furthermore, though not technically social support, the use of *virtual agents* may be an intervention feature that fulfills a similar need. Embodied conversational agents (ECA) - anthropomorphic characters that interact with users in human-like ways – can achieve some of the advantages served by guided interventions or peer support [106, 107]. Including ECAs may contribute to increased engagement and satisfaction with the intervention, perhaps even improving health behavior change [108, 109]. Importantly, virtual agents need not be advanced computer programs - simply including an avatar with specific characteristics may be sufficient to positively influence health outcomes [110].

The Function of Features:

An interesting finding that emerged during analysis was that individual features sometimes mapped onto multiple BCTs and PSD principles. As an example, the leaderboard feature of the *iGo* application was coded as enabling rewards (giving points for progress), self-monitoring (tracking this progress), and social support (comparing points with other users). Such mapping reveals a complex relationship between features as surface-level interface implementations and their connection to theoretically grounded constructs.

This observation points towards a potential distinction between features and their underlying *function* - the behavioral or psychological mechanism they are designed to activate within an intervention. Multiple features can serve the same functional purpose: giving points, displaying happy emojis, and receiving praise from a virtual agent all fulfill the reward function of reinforcing the desired behavior. It is these functions that represent the actual drivers of behavior change - "the levers we are pulling" to promote user engagement and intervention outcomes.

Understanding the functional role behind features may be critical for effective intervention design. Geuens et al. [111] discuss the importance of bridging the gap between health theory and app design, suggesting that when designers "lack understanding of the underlying psychological drivers" this may lead to "reductionist and naive interpretations and implementations." Simply implementing a feature without understanding its role in behavior change risks missing the mark - a prompting feature which reminds users in irrelevant moments fails to leverage the repeated prompt-behavior association central to habit formation.

Conversely, understanding these underlying psychological mechanisms enables designers to more effectively translate theoretical principles into design features. An interesting approach revealed by our analysis shows how one and the same feature can serve multiple functions simultaneously. Creatively designing such features may help to maintain a simple and clean interface while at the same time maximizing potential for behavior change.

Guideline recommendations:

Table 3

Recommended guidelines for designing digital mental health interventions, specifically for work

stress in an employee population.

Include self-monitoring, prompting, and personalization features DBCIs for work stress should continue to integrate established and common features such as self-monitoring, prompting, and personalization. These features demonstrate evidence of efficacy and can work synergistically, mirroring structures like those found in cognitive behavioral therapy.
Incorporate goal setting and reward features Goal setting and reward features, despite being underutilized in the reviewed interventions, are supported by evidence for promoting behavior change. Importantly, they can be smoothly integrated with above-mentioned features such as self-monitoring. Having users explicitly choose goals at the beginning of the intervention and creating a reward system whenever users make progress towards their chosen goal may help to foster a sense of achievement and sustained motivation.
Include scalable social support Embed social support features within the interventions and make use of scalable alternatives. For instances, it can be implemented among co-working employees or via built-in features that connect users. Additionally, virtual agents may fulfill some of the benefits of social support.
Design with purpose Develop an understanding of the psychological mechanisms that features are designed to leverage. Ensure that features have a clear role in driving behavior change or engagement. Find opportunities for developing features that fulfill several functions to keep a clean interface while maximizing impact.

Table 3 presents recommended guidelines as informed by our analysis. Comparing these guidelines with other literature, some recommendations align with previous work that similarly highlight the importance of self-monitoring, personalization, prompting, rewards, and goal setting features [40, 69, 74, 114]. Our recommendations expand on this by concretely suggesting how these features can work synergistically: personalized goals which the intervention prompts, monitors, and rewards based on user progress.

Furthermore, while the inclusion of social support features also appears across various guidelines, our focus on scalable alternatives addresses important implementation challenges. Fostering peer support among co-workers is especially useful in the context of the workplace. A final contribution lies in the emphasis on understanding the functional role of features, the purpose they serve in supporting intervention goals. This functional perspective, though not commonly highlighted in existing guidelines, offers important insight for translating behavioral science principles into effective interventions.

Limitations

One limitation regards the search of interventions which was not systematic and also omitted interventions not published in academic literature. Although it was not intended to be a fully

comprehensive search, this approach may have limited the identified interventions and potentially excluded relevant examples available through other sources or platforms. However, given that the aim was to conduct a more in-depth analysis of relevant peer-reviewed interventions rather than scoping the full range of interventions, the search strategy was deemed appropriate for this purpose.

Another limitation involved insufficient documentation of digital interventions. Several promising interventions were excluded from analysis, not because they were unsuitable, but because there was insufficient information and description to be able to conduct a thorough analysis. It is thus possible that high-quality interventions that could have contributed to meaningful insights were not included in the analysis. This limitation also highlights a need for more comprehensive reporting standards so that not only the research methodology but also the design of interventions can be properly evaluated.

Future directions:

The analysis focused on features currently implemented within the reviewed interventions, consequently resulting in guidelines based on observed practice rather than a complete exploration of all potentially applicable BCTs or PSD principles. Future research should aim to identify promising but overlooked techniques and investigate innovative ways to translate these into novel intervention features. For instance, the BCT category *Antecedents* which suggests strategies for restructuring the environment to support the desired behavior was not present in any of the reviewed intervention. This, alongside other rarely used techniques, could create new opportunities for promoting behavior change in digital work stress interventions.

Another direction involves further exploring the distinction between *features* (what users interact with) and the underlying *function* they serve (the psychological mechanism they activate). Clarifying this relationship may support much-needed efforts to develop a shared terminology within the field of digital health intervention research. Terms such as feature, strategy, technique, and component are often used interchangeably or ambiguously, creating confusion that can hinder scientific progress and effective collaboration [113, 115].

This feature-function distinction is uniquely well-positioned to bridge the interdisciplinary challenges inherent in this field. By acknowledging the different perspectives of health psychologists focused on behavioral mechanisms and interface designers focused on feature development, this lens provides a common language for collaboration. A deeper understanding of how these constructs connect could help developers better operationalize behavioral principles into features, ensuring that scientific insights are successfully translated into effective interventions.

Conclusion:

Current digital interventions for mental health often include a structure successfully synergizing self-monitoring, personalization, and prompting features. However, features related to goal setting, rewards, and social support are underutilized in the reviewed applications. Recommended guidelines for how to effectively integrate these features into digital interventions are provided. A distinction between features and their underlying function may provide a path towards improving our understanding of how to translate behavioral insights into effective intervention design.

Conflicts of Interest:

The authors have no conflicts of interest to disclose.

Author Contributions:

Leo Kowalski has contributed to conceptualization, data curation, data collection, formal analysis,

methodology, project administration, and writing. Anna Finnes has contributed to conceptualization, supervision, funding acquisition, reviewing, and editing. Sabine Koch has contributed to supervision, methodology, reviewing, and editing. Aleksandra Bujacz has contributed to conceptualization, data analysis, project administration, funding acquisition, methodology, supervision, reviewing, and editing.

Declaration of AI Use:

Artificial intelligence, specifically LLMs Claude and Gemini, were utilized to enhance the writing clarity of the manuscript. The AI served solely as an editorial tool - all conceptual contributions and interpretations are original to the authors. The authors assume full responsibility for the content and integrity of the final manuscript.

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Supplementary Files

Multimedia Appendixes

Table showing the Persuasive System Design model.
URL: http://asset.jmir.pub/assets/cd498b6845420f88a8f138d69597fe95.pdf

Table presenting the Behavior Change Technique taxonomy.
URL: http://asset.jmir.pub/assets/e8492ab953749df1f23d5db6cfe2c3dc.pdf