

HUMAN TECHNOLOGY

Volume 14, Number 2, August 2018

**SPECIAL ISSUE
DESIGNING INTERACTIVE SYSTEMS FOR
WORK ENGAGEMENT**

**Virpi Roto, Torkil Clemmensen, Heli Väättäjä,
and Effie Lai-Chong Law**
Guest Editors

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Human Technology, published by the Open Science Centre, University of Jyväskylä, is distributed without a charge online.

Guest Editors' Introduction**DESIGNING INTERACTIVE SYSTEMS FOR
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Work engagement is a complex phenomenon referring to a positive, fulfilling, affective-motivational state of work-related well-being. It is characterized by observable attributes such as vigor, dedication, and absorption (Schaufeli, Salanova, González-Romá, & Bakker, 2002). The majority of research on work engagement has been focused on understanding and evaluating the above specific attributes. Less research has explored how to design a work environment that can improve these attributes. Although Schaufeli, Bakker, and Salanova (2006, p. 702) stated that work engagement is “not focused on any particular object, event, individual, or behavior,” many aspects of the work context do influence work engagement, and these aspects can be influenced by conscious and systematic acts of design. The growth of scientific literature on, for instance, how workspace design, job design, and managerial guidance can improve work engagement shows the possibilities for and importance of design-oriented research on work engagement.

As digitalization and automation permeates all types of workplaces, it becomes difficult to find a job without some use of interactive technology. The increasing number and types of digital tools for all sorts of work implies that employees spend much of their working time with interactive technologies. Therefore, we find it surprising that research on designing interactive technologies for work engagement is such a neglected research topic. Below, we very briefly discuss the history and recent research of this field.

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DOI: <http://dx.doi.org/10.17011/ht/urn.201808103814>



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Because an interest in work engagement research stems from the positive psychology ideology (Hallberg & Schaufeli, 2006), a positive design (Desmet & Pohlmeier, 2013) approach, such as experience design (Hassenzahl, 2010), can be effective in improving work engagement via interactive technology in work contexts. Therefore, in the call for articles to this special issue, we emphasized experiential aspects and experience design as the means to address work engagement in interaction design.

BACKGROUND

The design of interactive systems for work contexts has been studied by human–computer interaction (HCI) researchers since the 1970s, but the focus of the first two waves of HCI research primarily has been on human factors, efficiency, and effectiveness. Only in the early 2000s has the third wave of HCI brought the engaging and experiential aspects of interactive technologies into attention (Bodker, 2006, 2015). Although positive user experience is an important design goal of today’s consumer products and services, the third wave in designing technology has not yet reached the workplace. Many companies have only recently realized that work tools should be selected not only for their performance, ergonomics, or safety improvement capability, but also for their ability to support the employees’ well-being at work and to improve work engagement. Companies and employees alike are seeing the benefit of utilizing other digital tools as well to help them in reflecting and improving well-being at work. The need is there, but do designers know enough of how to design such tools and services?

Only during the recent decade have user experience researchers started to explore work experiences in domains such as machine automation (Palviainen & Väänänen-Vainio-Mattila 2009), factory automation (Obrist, Reitberger, Wurhofer, Förster & Tscheligi, 2011; Wurhofer, Fuchsberger, Meneweger, Moser & Tscheligi, 2015), metal industry (Lu & Roto, 2014), or software development (Harbich & Hassenzahl, 2017). Most of these publications point out the lack of focus on user experience research in work context, as do Bargas-Avila and Hornbaek (2011) and Tuch, van Schaik, and Hornbæk (2016). Many of the theoretical findings in the above works could be utilized in designing for work engagement, but it is hard to locate scientific reports of such design cases.

If user experience research in the work context is lacking, experience design research regarding interactive systems at work seems to be almost nonexistent. The closest piece of research on experience design in work context seems to be reported in Lu and Roto (2016), who analyzed 20 design cases targeted at evoking pride experiences at work. But even this report lacks the implementation of existing theories in experience design. In summary, there is clearly a need for research on designing interactive systems for work engagement. Therefore, in this special issue, we wanted to highlight the means for designing engaging qualities into technology used at work. Figure 1 visually demonstrates how the trifold elements comprise the topics of this special issue.

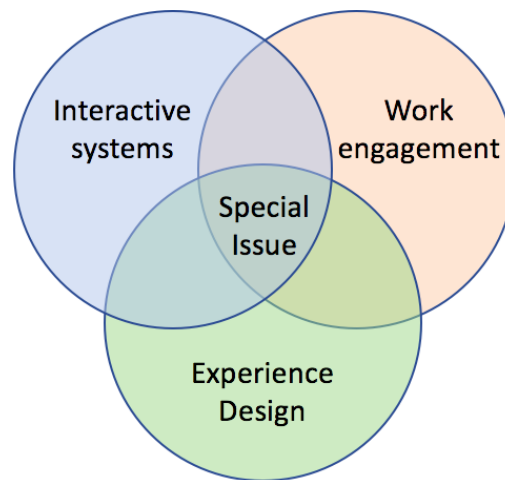


Figure 1. The scope of this special issue is in use of theoretical understanding of employee experiences in designing interactive systems for work engagement.

ARTICLES IN THIS SPECIAL ISSUE

In the call for papers for this special issue, we invited manuscripts that offered theoretical, methodological, analytical, or empirical contributions about designing interactive technologies and work tools with the aim to increase wellbeing at work and work engagement. We received 10 submissions of which 4 are published here after an elaborate review process. The four articles selected for publication introduce various means to improve work engagement. Nonetheless they share a common thread in that they are based on theoretical understanding of experiences at work. Three of the four articles report actual design cases that applied the gained theoretical understanding. The work contexts include factories, entrepreneurs, and office work.

The article by **Katharina M. Zeiner, Michael Burmester, Kristin Haasler, Julian Henschel, Magdalena Laib, and Katharina Schippert** reports the latest advances in methods that help designing for positive experiences at work. As the groundwork, Zeiner et al. analyzed 345 reports of positive experiences in various types of work environments and derived 17 categories of positive experiences at the workplace. In this article, Zeiner et al. provide guidance for and examples of the many uses of experience categories, such as making the experience interviews method more focused and efficient. The appendixes of this article provide printable versions of the experience interview template and Experience Cards. As Zeiner et al. suggest, the Experience Cards, experience interview, and experience potential analysis form a promising experience-centric approach to design for work engagement.

The three other articles study more specific phenomena to identify means to improve work engagement. Gamification is a common method for improving user engagement, and to an increasing extent, also in the work context. While the mainstream of work gamification studies focuses on individual workers, **Niko Vegt, Valentijn Visch, Arnold Vermeeren, and Huib de Ridder** studied how gamification can improve team cohesion and thereby work engagement in factory work context. By utilizing the theories of team cohesion and gamification, they designed and installed two interactive screens to communicate the

performance of two departments in a factory's production hall and canteen. Analysis of the use of this tool reveals, for example, that the screen led to an increased level of task commitment. However, the interactive screens did not prompt the employees to interact as much as Vegt et al. had anticipated, which raises the question of how to engage employees to use the interactive technologies that are designed to enhance work engagement.

In a semiconductor factory cleanroom context, employees' work is not full of exciting new experiences. Rather, routine tasks form a significant part of the work. **Thomas Meneweger, Daniela Wurhofer, Verena Fuchsberger and Manfred Tscheligi** point out that in these kinds of work contexts, designing for extraordinary experiences might be less important than designing for ordinary experiences of mundane tasks. The article thoroughly reviews the user experience research and highlights the overlooked research area of ordinary experiences. The article is a good example of in-depth research in an unexplored territory of experience design.

Päivi Heikkilä, Elina Mattila, and Mari Ainasoja focus on the eustress of entrepreneurs, that is, turning negatively perceived stressors into positive challenges. Heikkilä et al. first study entrepreneurs' experiences of eustress via interviews and diaries, based on which they derive six means to help entrepreneurs in handling stressors in their work. The six means were then used in developing a Web-based service, the Eustress Toolbox, that aims to improve entrepreneurs' skills in managing challenging stressors. This article contributes to the nascent literature on the influence of positive stress (eustress) in work engagement. It also addresses the design engagement challenge of Vegt et al. by proposing guidelines for designing the engagement tools.

CONCLUSIONS

From the articles in this special issue we can see that focusing on positive experiences in work contexts may require special forms of experience-oriented data collection and analysis—to bring up new insights into work stress and well-being and for creating innovative designs to improve work engagement. The articles highlight the special nature of work experiences and help the reader rethink the types of experience goals embedded in designing interactive systems for work engagement. The editors expect the articles in this special issue will make a significant contribution to the literature and inspire readers to tackle this emerging research field. The theoretical and empirical contributions such as those reported in the four articles, will help experience designers improve work engagement and well-being at work. Hopefully, this eventually will lead to professional tools that employees not only have to use but enjoy using, and even lead to human flourishing at work.

REFERENCES

- Bargas-Avila, J. A., & Hornbæk, K. (2011). Old wine in new bottles or novel challenges: A critical analysis of empirical studies of user experience. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2689–2698). New York, NY, USA: ACM.
- Bødker, S. (2015). Third-wave HCI, 10 years later—participation and sharing. *Interactions*, 22(5), 24–31.

- Bødker, S. (2006). When second wave HCI meets third wave challenges. In *Proceedings of the 4th Nordic Conference on Human–Computer Interaction: Changing Roles* (pp. 1-8). New York, NY, USA: ACM.
- Desmet, P. M., & Pohlmeier, A. E. (2013). Positive design: An introduction to design for subjective well-being. *International Journal of Design*, 7(3), 5-19.
- Hallberg, U. E., & Schaufeli, W. B. (2006). “Same same” but different? Can work engagement be discriminated from job involvement and organizational commitment? *European Psychologist*, 11(2), 119–127.
- Harbich, S., & Hassenzahl, M. (2017). User experience in the work domain: A longitudinal field study. *Interacting with Computers*, 29(3), 306–324.
- Hassenzahl, M. (2010). *Experience design: Technology for all the right reasons*. San Francisco, CA, USA: Morgan Claypool.
- Lu, Y., & Roto, V. (2016). Design for pride in the workplace. *Psychology of Well-being*, 6:6. <https://doi.org/10.1186/s13612-016-0041-7>
- Obrist, M., Reitberger, W., Wurhofer, D., Förster, F., & Tscheligi, M. (2011). User experience research in the semiconductor factory: A contradiction? In P. Campos, N. Graham, J. Jorge, N. Nunes, P. Palanque, & M. Winckler (Eds.), *Human-Computer Interaction – INTERACT 2011. Lecture Notes in Computer Science*, (Vol. 6946; pp. 144–151). Berlin, Germany: Springer.
- Palviainen, J., & Väänänen-Vainio-Mattila, K. (2009). User experience in machinery automation: From concepts and context to design implications. In M. Kurosu (Ed.), *Human-Centered Design. Lecture Notes in Computer Science* (Vol. 5619; pp. 1042–1051). Berlin, Germany: Springer.
- Schaufeli, W. B., Salanova, M., González-Romá, V., & Bakker, A. B. (2002). The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of Happiness Studies*, 3(1), 71–92.
- Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006). The measurement of work engagement with a short questionnaire: A cross-national study. *Educational and Psychological Measurement*, 66(4), 701–716.
- Tuch, A. N., Schaik, P. V., & Hornbæk, K. (2016). Leisure and work, good and bad: The role of activity domain and valence in modeling user experience. *ACM Transactions on Computer–Human Interaction*, 23(6), Art. 35.
- Wurhofer, D., Fuchsberger, V., Meneweger, T., Moser, C., & Tscheligi, M. (2015). Insights from user experience research in the factory: What to consider in interaction design. In J. Abdelnour-Nocera, B. R. Barricelli, A. Lopes, P., Campos, & T. Clemmensen, T. (Eds.), *Human work interaction design: Work analysis and interaction design methods for pervasive and smart workplaces* (pp. 39–56). Cham, Switzerland: Springer.

Authors' Note

This special issue was supported in part by the IFIP TC13 Working Group 13.6 on “Human Work Interaction Design” and by Dimecc Design for Value research program, funded by Business Finland.

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Human Technology
 ISSN 1795-6889
www.humantechnology.jyu.fi

DESIGNING FOR POSITIVE USER EXPERIENCE IN WORK CONTEXTS: EXPERIENCE CATEGORIES AND THEIR APPLICATIONS

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Abstract: *Experience categories describe repeatedly occurring qualities of positive experiences that can be used for the analysis and generation of new/further/more positive experiences. This paper describes experience categories for the workplace. Based on 345 reports of positive user experiences in the workplace, we identified 17 experience categories through qualitative content analysis and describe their necessary and optional attributes. We believe that experience categories can support analysis and design activities for the work place in three ways: (a) using the questions derived from experience interviews to analyze existing positive experiences in work contexts, (b) explaining the potential of positive experiences in work contexts as a formal analysis tool, and (c) showing the ways in which experience categories can inform the design of software concepts to foster/generate positive user experience. The experience category approach is thus a more actionable addition to other, mainly theory-driven, approaches.*

Keywords: *user experience, work, experience categories, positive design, interviews.*

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DOI: <http://dx.doi.org/10.17011/ht/urn.201808103815>



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INTRODUCTION

Experience categories (Zeiner, Laib, Schippert, & Burmester, 2016b) describe repeatedly occurring qualities of positive experiences. They can be used to study existing situations and to generate ideas and concepts that support positive user experience. In this paper, we investigate the literature regarding positive experience in general with the aim of applying these experience categories toward positive user experience with technology in the workplace. We achieve this by reanalyzing a data set on positive experiences in the workplace as well as the resulting experience categories in detail. Finally, we demonstrate how experience categories can be used to design new positive experiences in the workplace.

User Experience

User experience (UX) is defined by Hassenzahl (2008, p. 12) as “a momentary, primarily evaluative feeling (good–bad) while interacting with a product or service....good UX is the consequence of fulfilling the human needs for autonomy, competency, stimulation (self-oriented), relatedness, and popularity (others-oriented) through interacting with the product or service (i.e., hedonic quality).” This definition significantly advanced the understanding of what UX is and how positive UX arises. Compared to the very broad definition in the ISO 9241-210 standard (International Organization for Standardization [ISO], 2010), Hassenzahl’s (2008) definition clearly focused on the user’s emotion and the fulfillment of psychological needs.

One direct application of this is experience design (Hassenzahl, 2010), which aims to describe how technologies can be designed to facilitate positive experiences (Hassenzahl, Diefenbach, & Göritz, 2010; Hassenzahl et al., 2013). Because technology is an integral part of modern work—and, according to Chui and colleagues, knowledge workers spend on average 28 hours per 40-hour workweek using technology (Chui et al., 2012)—an essential goal must be to better understand positive UX in the workplace. However, exactly this is seemingly neglected by UX research (see critiques in Bargas-Avila & Hornbæk, 2011, 2012). A recent exception is an in-depth analysis of need fulfillment in leisure and work situations by Tuch, van Schaik, and Hornbæk (2016). Furthermore, the limited research to date shows that users of enterprise software prefer software showing hedonic qualities (Schrepp, Held, & Laugwitz, 2006), as well as software inducing positive UX and improving the motivation to work on tasks (Kohler, Niebuhr, & Hassenzahl, 2007). Harbich and Hassenzahl (2008) proposed that technology in work contexts should be designed to execute tasks (usability), engage users, and be able to evolve and to expand from the original task. More recently, our research lab showed that the demanding work of field sales personnel can be improved by designing for positive social relationships with their customers and for expressing and receiving gratitude for contributions in their customer relationship management system (Burmester et al., 2015). Lu and Roto (2015) proposed a design approach for meaningful work based on the positive design framework (Desmet, Pohlmeier, & Forlizzi, 2013) and a theory of meaningful work by Rosso and colleagues (Rosso, Dekas, & Wrzesniewski, 2010). Furthermore, they analyzed and explored designs for the experience of pride at work (Lu & Roto, 2016).

Positive Psychology in Technology Design

Positive psychology and its idea of researching what makes people happy and contributes to their well-being are now used also in design. Positive design (Desmet & Pohlmeier, 2013), for example, aims to design for human flourishing. This design approach suggests three ways to reach this goal:

- design for pleasure by creating positive emotions,
- design for personal significance by supporting people in pursuing their personal goals, and
- design for virtue by helping people be morally good persons.

Therefore, design of technology should either facilitate new positive experiences or foster already existing positive experiences through the design of technology. Positive technology (Botella et al., 2012) in turn investigates how technology can be used to improve personal experiences. Technologies are assigned to three categories according to their purpose:

- technology to improve the mood (hedonic),
- technology to support self-realization (eudaimonic), and
- technology to create and improve interpersonal bonds (social).

Calvo and Peters' (2014) approach to positive computing deals with designing technology to improve well-being and to support people in using their full potential. All three approaches support design for positive user experience in digital products.

Designing for Positive Experiences

There are several ways to design for positive UX. This includes theories such as Hassenzahl's needs approach (Hassenzahl et al., 2010, 2013,) or the 25 positive emotions of product use by Desmet (2012; Yoon, Desmet, & Pohlmeier, 2013). The wellbeing determinant cards of Calvo and Peters (2016) reflect a variety of theoretical approaches of positive psychology and can be used as inspiration for design ideas. However, these theory-driven approaches and tools might be too broad and, as a result, difficult to apply to specific contexts such as various work environments or tasks. In order to generate positive experiences for specific situations (e.g., smart kitchens), it helps to better understand the already existing positive experiences in the context of interest (e.g., cooking in general). Several approaches to this exist, for example, the experience reports (Hassenzahl et al., 2010), experience narratives (Tuch, Trusell, & Hornbæk, 2013), and experience interviews (Zeiner, Laib, Schippert, & Burmester, 2016a). All these methods are variations on Flanagan's (1954) critical incidents method. The difference between the former two approaches and experience interviews is that experience reports and experience narratives address the experiences under investigation as a tool to generate overarching experiences that allow researchers/designers to gain a better understanding of UX rather than trying to categorize the experiences to improve understanding of the experiences themselves. Experience reports show how the fulfillment of needs leads to positive experiences. Experience narratives are analyzed using both manual and automatic content analyses and reveal the relationships between experiences and technology use, situational aspects, emotions, and needs. Experience interviews, on the other hand, qualitatively explore structures within experiences, and thus underscore the fundamental importance of the experience, which may or may not lead to UX applications.

Previous Work on Experience Interviews and Experience Categories

To inspire software design and to support positive UX with technology, understanding better the already existing positive experiences in similar contexts is paramount. An experience (derived from Hassenzahl, 2008, 2010) is an emotional episode related to a certain context; a positive experience is an emotional episode in a certain context with a positive valence (Russell, 2009). In the experience interview (Zeiner et al., 2016a), we developed a method that supports researchers in analyzing experiences within certain contexts and designers in understanding positive experiences that can be used to generate new ideas for positive UX.

Experience Interviews

In these semistructured narrative interviews, participants were asked to tell the interviewer about a positive experience they recently had in a given context (here work). The interviewer then asked for any additional information that is needed to get a full understanding of the positive experience—for example, any feelings experienced (“How did you feel?”), specific work activity carried out (“What did you do?”), other people involved (“Who else was there?”), technology used (“Was your experience influenced by technology?”), time structure of the experience, potential factors driving the experience, and environmental conditions. To make the face-to-face interviews a shared activity with the participant, we developed a worksheet (see Figure 1; for a printable version see Appendix A) that the interviewer and participant completed together.

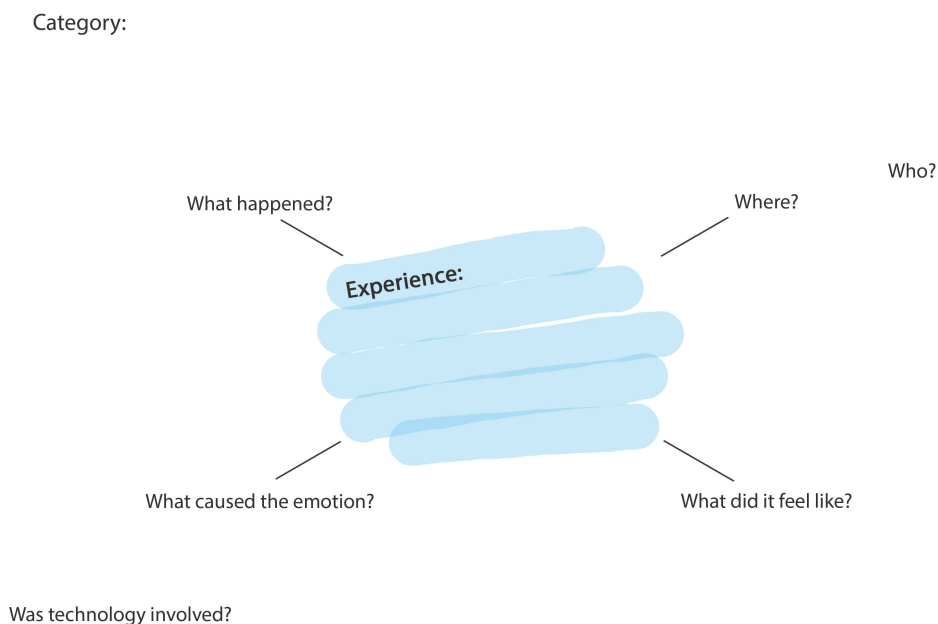


Figure 1. The experience interview worksheet. This worksheet can be used to support the experience interviews. The main questions of the interview are included, surrounded by white space to record additional information about the experience. In the middle the interviewer and interviewee can decide on a fitting title/description for the experience.

The worksheet allows participants to validate and complete the notes directly during the interview (see Figure 2a). An added benefit of documenting the interviews using a type of worksheet (as opposed to first recording the interview and then transcribing it) is that it greatly simplifies the analysis process. The interview worksheets can be compared and clustered based on the themes reported in the interviews (see Figure 2b)

Experience interviews need not be conducted only face-to-face. We developed an online version that produced comparable results as the face-to-face version; thus we have been using the two together. In the online version, participants are asked the same questions as in the face-to-face interview, but they complete the documentation themselves. While that eliminates the opportunity for a researcher's follow-up questions, the explicitness of the questions asked in both versions means there often were very few follow-up questions even in the face-to-face version. Participants of the online questionnaire were conscious that the descriptions they provided were our only data source and provided us with clear and precise descriptions of their experiences. For example, when asked about whether technology was involved in the experience, responses are often as precise as *"I used technology [our intranet] in this situation but the positive experience itself was not caused by the technology"* (PO226).¹

Experience interviews can be analyzed in two ways. Information about the experiences is entered into a spreadsheet and analyzed using qualitative content analysis (Mayring, 2000), which is crucial when analyzing data to derive categories or other aspects needed for research. However, this method is not feasible for use by practitioners with limited time or other resources. Alternatively, the worksheets of all interviews can be analyzed as a whole. The project team can cluster the experiences to form categories of experiences, for example, according to their causation or according to the emotions they generated. This process can be easily integrated into creative design processes and illustrated in Figure 2b. We used this process for our research, and it is described in more detail in Zeiner et al. (2016a).

To date, our group has conducted more than 1,000 experience interviews in various contexts, both professional and personal. The contexts include work environments, cooking, train stations, friendships, and interactions with products (e.g., apps and online shopping platforms) or 3D software. This paper, however, narrows the focus to the work context.

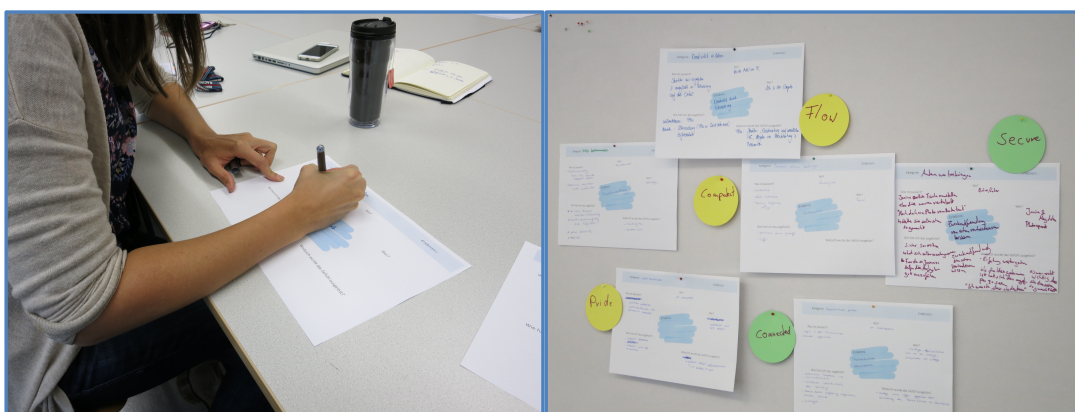


Figure 2. (a) Interviewer using the worksheet from the perspective of an interviewee, and (b) clustering the collected experiences after several interviews have been conducted.

Data Collection

In relation to positive experiences at work, 349 descriptions of positive experiences at work were collected. Of these, 223 were collected face-to-face and 126 online. The face-to-face interviews were all conducted in German. The online version was available both in German and English. Of the collected experiences 320 were reported in German, 29 in English. Twenty-nine of these reported experiences contained multiple individual experiences that were separated into smaller, self-contained experiences (several the reports contained more than two experiences and were split accordingly). Of these now 381 experiences, 32 were excluded because they either described usability or were not positive. The remaining 349 experiences were analyzed and classified. Because the sample was very diverse, we decided not to compare the descriptions based on sociodemographic factors but treat the sample as one large group. We are planning to explore the sociodemographic factors further in a future study.

Participants represent a wide range of occupational and educational backgrounds, such as various types of engineers, academics, landscape gardeners, teachers, therapists, military personnel, and students. The vast majority of our participants spent at least part of their workweek in office environments.

In a previous publication (Zeiner et al., 2016b), we identified 21 experience categories for work contexts from this data set. In this current paper, we reanalyze the data set with the goal of specifically exploring the qualitative aspects of the categories and gaining a fuller understanding of how the different categories relate to each other.

The experiences were categorized separately by three members of our lab (including Zeiner & Laib) using Mayring's (2000) step model of inductive category development. In a final step, either the pattern with the highest proportion of agreement was chosen or, in cases of disagreement, the ratings were discussed among the raters to reach consensus. We found no significant differences in the occurrence of categories between the two language groups using a two-sample Kolmogorov–Smirnov test, $D(320,29) = 0.23$, $p = 0.12$. Furthermore, we found no systematic qualitative differences, so we decided to treat them as one sample.

Prior Findings

In our previous analysis, we found that nearly 80% of the reported positive experiences involved other people (see Zeiner et al., 2016b, for more detail). However, technology seemed to play a larger role in positive experiences when participants were alone (67% of experiences alone vs. 27% of experiences with others), suggesting that there might be potential for creating positive experiences with other people and technology at work. There also seems to be a strong effect of hierarchical structures at work on the descriptions. For example, more positive experiences were reported for interactions with colleagues than with superiors or externals such as customers.

Although this original analysis allowed for the experience categories to be extracted, it was by no means an in-depth analysis. What soon became apparent was the need for a more detailed description that included specific information about the different categories. That is the intention of this paper. Thus, the reanalysis aimed to answer the following questions:

1. How do the different experience categories relate to each other?
2. What are the reoccurring aspects noted in Zeiner et al. (2016b)? Can these aspects be described as “must-have” and “optional” attributes?

EXPLORING THE RELATIONSHIPS AND STRUCTURES OF EXPERIENCE CATEGORIES

Definition and Structure of Experience Categories

Participants repeatedly reported similar experiences that formed the basis for experience categories. We define experience categories as follows:

- Experience categories describe qualities within positive experiences that occur either in every experience or in a high percentage of them.
- These qualities are described as activities because experiences are rooted in activities (Hassenzahl et al., 2013), and this description allows for a more direct application.
- Within an experience category, similarities appear frequently in the qualities of the facilitating factors (e.g., presence of others, special activities, technology).

Thus the categories describe the essence of clusters of positive experiences. Each experience was assigned to a category that described the situation. We identified 17 experience categories, which are listed in Table 1. These experience categories (described on a superficial level in Zeiner et al., 2016b) differ in their reported frequency. The differences in frequency correspond to the differences between experiences alone and those with others. We do not believe this implies that certain categories are easier to elicit per se. Rather, we believe that this reflects the environment and structures in the work context and that most categories could be elicited by creating the structures that support them.

Several categories seemed related and could be grouped together, such as Giving Feedback, Receiving Feedback, and Appreciation. The common aspect of these three experience categories is that people respond to each other in a positive way that we called Resonance. Social Support is a group of experience categories consisting of Helping Others, Receiving Help, and Teaching Others. The common element in this grouping is the mutual support at work that is experienced in a very positive way. The group termed Challenges represents a very important set of experience categories: Rising to a Challenge and Being Given a Challenge. Solving a Problem and Experiencing Creativity are experience categories contributing to engagement and flow and thus are grouped within Engagement. The group Organization combines experience categories related to managing and finalizing one's work. The experience categories in this group are Finishing a Task and Keeping Track of Things. The final group, Communication and New Experiences, is a combination of communication aspects and one's striving for the new (both alone and with others), which are the categories Connecting with Others, Exchanging Ideas, Stimulating Experiences, Creating Something Together, and Contributing to Something Greater.

Distilling the Structures of Experience Categories

Data and Analysis

The data set presented in this content analysis was the same as the one used for the original analysis in Zeiner et al. (2016b). Although the categories described in Zeiner et al. (2016b) allowed for insights when analyzing experiences and designing for new experiences, the goal in the current analysis was to provide a more structured approach. To do so, the qualitative data

Table 1. Consolidated Experience Categories Including Frequency and Number of Experiences. Related Categories Are Clustered into Groups.

Experience Category	Percentage	Experiences	Group
Receiving feedback	13.9%	79	Resonance
Giving feedback	1.2%	(22.9%)	
Receiving appreciation	7.8%		
Helping others	5.2%	35	Social Support
Receiving help	3.5%	(10.1%)	
Teaching others	1.5%		
Rising to a challenge	21.7%	88	Challenge
Being given a challenge	3.8%	(25.5%)	
Solving a problem	1.7%	14	Engagement
Experiencing creativity	2.3%	(4.1%)	
Finishing a task	4.3%	37	Organization
Keeping track of things	6.4%	(10.7%)	
Connecting with others	4.1%	92	Communication and New Experiences
Exchanging ideas	4.6%	(26.7%)	
Experiencing something new	7.0%		
Creating something together	8.4%		
Contributing to something greater	2.6%		
Total	100.0%	345	

Note. The original data set contained 349 responses. However, during reanalysis, the researchers perceived that four responses were less positive experiences than the absence of negative experience. Thus, these four responses were eliminated from further evaluation.

collected as experience stories in the interviews of the categories were examined more closely and analyzed for the experiences contained within them. This was done using the following procedure:

1. Using qualitative content analysis (Mayring, 2000), themes in the reported experiences were identified and clustered accordingly.
2. The factors contributing to the positive experiences were isolated.
3. The experiential outcomes (i.e., the emotions participants reported rather than our interpretation of what they might have felt) were analyzed.
4. From this qualitative analysis, we compiled a list of recurring descriptions and attributes.

This list of descriptions was then discussed by a team of three experts (Zeiner, Schippert & Haasler) with in-depth knowledge concerning experience interview data. Rather than arriving at separate lists and calculating inter-rater reliability, we employed a collaborative approach. The various lists of descriptions were compared and combined into a final list on which all experts agreed. This was done to reduce over-interpretation of the data. During this stage of the analysis, four experiences were excluded from the data set because all raters agreed that they

were not truly positive experiences but rather descriptions of an absence of negative experiences. This means 345 experiences formed the final data set.

During the qualitative content analysis, we noticed that some aspects and attributes were reported in each experience of a category while others were reported less frequently but still repeatedly. This led us to derive a list of “must-haves” and “optional attributes” for each of the categories. Must-haves are attributes that occur in some form in every experience reported within that category. Optional attributes occur in some form in several of the experiences reported within that category but not in all. Sometimes these attributes are concrete behaviors or actions; sometimes these are a focus/intent of an action or its emotional result. Participants frequently reported the emotions they felt during the experience. Although not systematically collected, these emotional descriptions were useful in gaining a better understanding of the category. In future data collections, such information might allow for a comparison between positive emotions and the categories. This comparison would bridge the gap between the positive emotions (Yoon et al., 2013) used in positive design and the experience categories. At the moment, however, sufficient data are not available to address this issue systematically. Therefore, we chose to simply report the experiential outcome. We hope to supplement this with an in-depth analysis in a future study.

For each category, a social index was calculated—a number that described to what extent the category was experienced with others. The index represents the number of experiences with others divided by the number of all experiences (i.e., whether alone and with others). If only experiences alone were reported, then the social index would be 0. The social index would be 1 if only experiences with others were provided by the respondents. It should be noted, however, that we rarely find categories with a social index lower than 0.5 in our studies on positive experiences in our lab. For each specific experience category, the social index is a means of describing how important social interactions are for the category. This is useful for analysis purposes (in that some categories are more social than others) or concept generation (e.g., if a designer is working on a concept that involves interactions between several users then the categories with a lower social index might be harder to design for than ones with a higher social index).

Findings: Description of Experience Categories

In this section, we present details on the groups and categories by describing their similarities and differences. Each group description is followed by a table that lists the must-have and optional attributes within the categories, their experiential outcome, and the social index. The tables are intended to be used as a quick guide when comparing the different categories.

Group: Resonance

Resonance combines three similar categories related to the experience of feedback. Feedback is fundamental to nearly all the other categories but nowhere more so than in this group. The difference between these categories lies within the type of feedback. The Receiving Feedback category represents situations where someone comments on one’s competency. A typical type of positive feedback could be, “Thank you for compiling the spreadsheet. The way you organized things made it really easy for me to continue working on the project.” On the other hand, Receiving Appreciation involves more personal feedback, such as “Thank you for helping me

with this presentation. I know you did not have to help me,” thus making clear that the sender is commenting on the receiver’s personal traits. Finally, Giving Feedback can involve feedback given to another about performance, but it seems that it often also has an appreciation component. Here we hypothesize that, for a person to experience giving feedback as positive, it has to contain an emotional aspect, thus making situations that involve appreciation more likely to be described. The category Earnings (i.e., financial compensation) that was found in the previous analysis of the data was merged with the category Receiving Feedback upon reanalysis.

All Resonance situations lead to similar emotional responses. People feel pride in their work or themselves; they feel connected to their surroundings, as well as feeling validated and vindicated. As is to be expected with these categories, their social index is fairly high: The social index for Receiving Appreciation was 0.90; Giving Feedback and Receiving Feedback were both 1.0. This information is summarized in Table 2.

Group: Social Support

The group Social Support comprises the categories Helping Others, Receiving Help, and Teaching Others (see Table 3). Unsurprisingly, the social index for each of the categories is 1.0. The aspect uniting these categories is support that is either given or received and experienced as positive. When people are helping others—particularly when giving support or advice—they often see themselves in a mentoring role. However, the main goal of this support is not to assist or teach the recipient so he/she can solve whatever problem is confronted currently without assistance in the future. Rather, Teaching Others can embody altruistic intentions. Some of the collected experiences suggested that teaching and helping others also is used to show off one’s own skills and knowledge. Receiving Help has the most positive effect of the three categories in this group. Because help is perceived as positive when people have identified a problem or a question themselves, they feel connected to the person who helped them.

Table 2. Experience Categories of the Group Resonance. Listed are Must Have and Optional Attributes, the Experiential Outcome, and the Social Index for Each Category.

Must Have	Optional	Experiential Outcome	Social Index
Receiving Feedback			
Positive feedback about performance Focus on competency	Praise Feedback through, other people, technology, or through own impression	Relief Pride Validation/affirmation	0.93
Giving Feedback			
Giving positive feedback about performance	Showing appreciation	Feeling of connectedness	1.00
Receiving Appreciation			
Feedback about appreciation of one’s self	Stronger effect if unexpected Competence	Feeling vindicated Pride	0.90

Table 3. Experience Categories of the Group Social Support. Listed are Must Have and Optional Attributes, the Experiential Outcome, and the Social Index for Each Category.

Must Have	Optional	Experiential Outcome	Social Index
Helping Others			
Responding to problems or questions by imparting support or advice	In response to a request or through initiative of one's own, or with customers or colleagues Mentoring role	Joy over the received appreciation Feeling competent & self-confident, Pride	1.00
Receiving Help			
Receiving support or advice in response to problems or questions	Before: uncertainty, distress	Appreciation Relief Connectedness	1.00
Teaching Others			
Acting as a mentor, supervisor, or leader Sharing experiences and knowledge Intention: teaching others	Receiving appreciation Feeling responsible for others Perceiving own professionalism	Feeling Competent Pride	1.00

Group: Challenge

As presented in Table 4, the categories Rising to a Challenge and Being Given a Challenge are related to the feedback categories. When someone has been working on a difficult problem or project, some kind of feedback makes them notice that they have completed it. Unlike in the Giving Feedback category, however, the other person (if involved) recedes into the background over the sense of achievement in completing the challenge successfully. This is reflected in the low social index of 0.68. Being Given a Challenge describes experiences that occur when people are given a demanding task by their superior, by someone from outside one's work hierarchy, or by technology. People perceive this challenge as positive if it stretches their abilities but is achievable. Here the social index is higher at 0.85.

Group: Engagement

The Engagement categories Solving a Problem and Experiencing Creativity (see Table 5) are more inward-facing, which is reflected in their low social indices (0.50 and 0.38, respectively). A core requirement seems to be that, although the goal is clear, there is freedom of choice as to how the goal is reached. Both categories require a level of competence, meaning that all the skills needed to perform the task are available. The difference between the two categories is the level of skills. When solving a problem, the task is doable but is perceived as a stretch. When a worker experiences creativity, however, he/she is more certain of his/her skills. In such situations, the worker starts playing with the problem, which can lead to taking unconventional paths and responding to changing requirements. Sometimes the process leads to the experience of flow (Csikszentmihalyi, 1990). For example, participant PO322 described a situation where she experienced creativity with her line manager in a meeting: They were talking about their research

and were spinning ideas. As a result, “*stuff just flowed.*” The focus of the meeting was not productivity or the result. (Indeed, the participant stated that the meeting was not even the “*most productive*” she had attended in her career). Rather, the focus of the meeting emphasized the experience itself.

Group: Organization

Organization combines experience categories around managing and finalizing the work. As provided in Table 6, the experience categories in this group are Finishing a Task and Keeping Track of Things. As with engagement, these categories are inward-looking, and thus with low social indices (0.47 and 0.50, respectively).

Table 4. Experience Categories of the Group Challenge. Listed are Must Have and Optional Attributes, the Experiential Outcome, and the Social Index for Each Category.

Must Have	Optional	Experiential Outcome	Social Index
Rising to a Challenge			
Uncertainty about results	Tension or skepticism in the beginning	A sense of achievement	0.68
Completing a difficult task	Rising to their own demands	Pride	
Positive feedback about performance	Working alone or in a team	Feeling of being needed	
Satisfaction with results		Self-confidence	
Relief if things worked out			
Being Given a Challenge			
Given a (new) difficult task	From a customer or supervisor	Motivation	0.85
	Uncertainty in the beginning	Pride	
	Situation is interpreted as a show of confidence	Excitement about new experiences	

Table 5. Experience Categories of the Group Engagement. Listed are Must Have and Optional Attributes, the Experiential Outcome, and the Social Index for Each Category.

Must Have	Optional	Experiential Outcome	Social Index
Solving a Problem			
Goal is clear	Time becomes less important	Pride in the Results	0.50
Road to the goal is open	Exploring new things		
Competence (skills needed to complete task are present)	Assessing different possibilities		
Experiencing Creativity			
Trying out one's self and new ideas	Non-rigid structures'	Flow	0.38
Time becomes less important	Experiencing freedom	Motivation	
Goal is clear	Taking unconventional paths		
Road to the goal is open	Responding flexibly to changing requirements		
Competence (skills needed to complete task are present)			

Table 6. Experience Categories of the Group Organization. Listed are Must Have and Optional Attributes, the Experiential Outcome, and the Social Index for Each Category.

Must Have	Optional	Experiential Outcome	Social Index
Finishing a Task			
Completing tasks and parts of tasks	Initiating the activity might take some effort	Relief	0.47
Competence (skills needed to complete task are present)	Before: feeling of stress and tension	Pride	
Goal is clear	Positive feedback about performance	Feeling productive	
Task is not challenging			
Keeping Track of Things			
Keeping track of things	Perceived efficiency	Feeling of competence	0.50
	Functioning communication within a group	Pride over what has already been achieved	
	Having a plan	Relief	
	Setting priorities	Feeling of connectedness within groups	

Group: Communication and New Experiences

Finally, Communication and New Experiences involves both activities allowing a feeling of being related to others and one's exploring new things. Although this might sound like distinct types of categories, a large amount of overlap is apparent in their optional attributes (see Table 7). The categories Connecting with Others, Exchanging Ideas, and Creating Something Together are incredibly social (social index of 1.0). In these categories, the aspect of doing something with another person is most important and a great source of positive emotions. On the other hand, the categories Experiencing Something New (social index 0.52) and Contributing to Something Greater (social index 0.78) have lower social indices. The Experiencing Something New category describes stimulation through something novel. The category Aesthetics that was described in the previous analysis (Zeiner et al. 2016b) was merged with this category upon reanalysis. In comparison, Exchanging Ideas comprises stimulating experiences where the focus is on the connection with another person. Connecting with Others is very similar to exchanging ideas but without the focus on stimulation. Creating Something Together shares similarities with the Engagement categories but has a much stronger focus on the connections with others. Contributing to Something Greater also involves creating things, but here the focus is not on the connection with others but rather the connection with an outcome or development that is notable or valuable for the person. This can be religion (PS57) or other metaphysical or transcendent value, but typically in the work context, the more common experience tends to involve more practical efforts, such as on open source projects (e.g., PO299) or research (e.g., PC20).

Table 7. Experience Categories of the Group Communication and New Experiences. Listed are Must Have and Optional Attributes, the Experiential Outcome, and the Social Index for Each Category.

Must Have	Optional	Experiential Outcome	Social Index
Connecting with Others			
Shared activity (online or in person)		Feeling of connectedness Feeling appreciated	1.00
Exchanging Ideas			
Being interested in the other person Showing interest Talking to others	Expressing one's self Knowing each other or getting to know each other Sharing tasks Staying in touch Motivating each other	Empathy Connectedness	1.00
Experiencing Something New			
Interest and fascination in new things (stimulation) Active or passive exploration of something new	Leaving familiar surroundings behind Making new connections Responding flexibly to new situations Collecting impressions, experiences, knowledge	Is experienced as enriching Joy, fun, curiosity,	0.52
Creating Something Together			
Working towards a shared goal Clearly defined tasks Agreeing with others on the plan of action	Motivating each other Learning from each other Finishing tasks towards the main goal Relaxed working atmosphere Acquiring new skills		1.00
Contributing to Something Greater			
Doing something meaningful Acting on one's own principles Acting of one's own volition	To stand up for something	Confirmation Satisfaction	0.78

Discussion Regarding Experience Categories

The primary goal of this reanalysis was to explore specifically the qualitative aspects of the categories and to gain a fuller understanding of how the various categories relate to each other. In this subsection, we discuss the findings for each group of categories. Because the experiences were analyzed using inductive qualitative content analysis, the categories differ somewhat from the 21 categories reported our original analysis (Zeiner et al. 2016b). For example, in our earlier study, Competition, Earnings, and Aesthetics were very small categories, containing two experiences each. Although the first analysis suggested that these were individual categories, our more in-depth analysis that extracted the must-have and optional attributes uncovered that, in reality, they were instances of the larger categories

Receiving Feedback, Rising to a Challenge, and Experiencing Something New, respectively. Thus, they were incorporated into these categories.

Group: Resonance

The categories within the group Resonance represent situations that lead to similar emotional responses. People feel pride about their work or themselves; they feel connected to their surroundings as well as validated and vindicated. As can be expected with these categories that integrate significant interpersonal interaction, their social index is high (ranging between 0.90 and 1.0). Representing nearly 23% of the reported experiences, Resonance-related situations are experienced frequently.

Group: Social Support

The group Social Support, unsurprisingly, contains categories each with the social index of 1.0. They represent just over 10% of the reported experiences. A key rationale for uniting these categories is the aspect that the support, given or received, is experienced as positive. There appear to be strong links between these categories and the psychological need for popularity (Hassenzahl et al., 2010). We are currently exploring this connection further.

Group: Challenge

The categories within this group are related to the feedback categories in the Resonance group because it is feedback that initiates the realization that a challenge has been completed or that being given a challenge was perceived as a form of positive feedback. Because the focus of the Rising to a Challenge category is more inward-facing, it has a lower social index of 0.68. However, Being Given a Challenge has a higher social index of 0.85. This does not necessarily have to reflect that Being Given a Challenge means that someone has to actively give the challenge but more likely reflects the fact that by the time one has completed a task or problem and has risen to the challenge that whoever/whatever gave them, the challenge has become less important by comparison and the focus has shifted to the fact that the challenge has been completed. Challenges are perceived as positive if they are stretching the person's abilities but only to the extent that appears achievable. A similarity exists between this group and aspects of goal setting and the high performance cycle (Locke & Latham, 2002). This group also mirrors the concept of accomplishment in Seligman's PERMA model (Seligman, 2011). This group represents more than 25% of the reported experiences.

Group: Engagement

The Engagement categories focus on the individual, which is reflected in the categories' low social index (0.50 and 0.38, respectively). They share a large number of elements with the origins of flow (Csikszentmihalyi, 1990), such as the clear set of goals and balance between the perceived challenge and the perceived skill. The main difference between these two categories is the (self-)perceived skill. While solving a problem might feel like a task, creativity is experienced when the individual feels like he/she is playing with the problem. But in both cases,

the person is engaged in the task at hand. We are currently exploring the nuances between these two categories in a follow-up study. They represent just over 4% of the reported experiences.

Group: Organization

The Organization group contains categories that address structure and the activity of work. As with the categories in Engagement, these categories are inward-looking, with low social indices (0.47 and 0.50, respectively). They represent just below 11% of the reported experiences. The attributes of these categories suggest a strong link to the psychological needs for competence and security (Hassenzahl et al., 2010), which both turned out to be salient of positive technology experiences at work (Tuch et al., 2016).

Group: Communication and New Experiences

The Communication and New Experiences group is the largest group, representing over 26% of reported experiences and involves both activities and processes that allow a feeling of being related to others and the activity of exploring new things. Both aspects can be related to the psychological needs for relatedness and stimulation, as described by Hassenzahl and colleagues (2010). The three categories that involve interaction, idea exchange, and collaborative work, unsurprisingly, are incredibly social (each with a social index of 1.0). But the other two categories represent experiences that are more individualized, with Experiencing Something New having a social index of 0.52, and Contributing to Something Greater having a slightly higher social index of 0.78.

A common thread ties this group together. For example, stimulation is the foundation for both the Experiencing Something New and Exchanging Ideas categories. However, the stimulation in the former is primarily on the experience whereas in the latter it is in the shared connection in the activity. Similarly, Connecting with Others corresponds to Exchanging Ideas but without the focus on stimulation. Here similarities to the idea of Love 2.0 (Fredrickson, 2013) emerge. Creating Something Together shares similarities with the Engagement categories but has a much stronger focus on the connections with others. Contributing to Something Greater also involves creating things, but here the focus is not on the connection with others but rather the contribution to a valued goal or outcome (see Seligman, 2011), incorporating one's attachment to meaning and value oriented activities. Here parallels to awe (Keltner & Haidt, 2003) emerge.

Social Index

As mentioned earlier, a social index was calculated for every category. The social index indicates to what extent the category is experienced with others. This measure of social interactions in a given category represents the status quo at the workplaces of our participants, not a representation of all possible experiences in a given category. The social index was calculated as an aid for designing new interactions. For example, if an interaction (that is being designed) already involves several people, it is more straightforward to create a situation where an individual might receive feedback (social index = 0.93) than one where an individual might experience creativity (social index = 0.38). This does not mean that it is

impossible to create a situation where a person receives help that involves no other person even though the category Receiving Help has a social index of 1.0. It means that current workplaces do not facilitate this kind of experience (or at least it has not been reported to us so far). So, because the social index is a reflection of the status quo, it might be harder to create these situations given the restraints of current workplaces. What this also means, however, is that choosing a highly social category for a solitary activity and designing for it could also be used as a way to create unusual and thus highly stimulating experiences.

APPLICATIONS OF AN EXPERIENCE-CENTRIC APPROACH

The experience categories were developed with a clear purpose: Beyond gaining a better understanding of the structure of positive experiences in work contexts, the goal was to develop tools and methods that could be used to create positive UX by researchers and practitioners alike. This section is intended to give an overview of how the experience categories can be used and how they have been used within our own research group.

The experience categories can be used in several ways. The experience interviews that were used originally to establish the experience categories in themselves can be directed by focusing only on a few experience categories rather than all possible experiences. The categories can be used as an inspirational aid during the design process, or they can be used to analyze task and situational aspects in order to reveal potentials for new positive experiences with a product or service. While it would be possible to focus on experience categories during the entire design process, we successfully have been using the categories at various points within a larger process. We now provide examples of how the categories can be applied. We begin with an explanation of the original version of the experience interview as a comparison to the short version.

Original (or Long) Version of the Experience Interview

The original version of the experience interview (Zeiner et al., 2016a, 2016b) was developed by our group as a means to better understand positive experiences. In its original form, it is similar to narrative interviews and it was used to collect the data in this paper. It also has been employed in several other projects in our and other labs (e.g., Zeiner et al., 2018). Here we will describe one of them to visualize the process and its results here.

Together with a small software company that, among other things, produces project management software, we used the experience interviews to design concepts (for products) with positive UX for their project management software. The project was part of a larger course project with students at Stuttgart Media University. In order to develop the concepts, project managers and project leaders were interviewed about their positive experiences at work. Several participants in the interviews mentioned teamwork on a larger project as positive experience, and especially the feeling of working together to contribute to something greater. This led to the concept of a project meeting point, a virtual table at which each user is represented by a profile picture. The group's progress is visualized as a pie chart in the middle of the table. The project meeting point supports these experiences by providing visuals on the group's overall progress and supports a feeling of connectedness within the team. This was supposed to fulfill the psychological need for relatedness (Sheldon, Elliot, Kim, & Kasser, 2001).

Another type of positive experience common among the project managers was finishing tasks (or parts of them). To support this, the milestone tower concept was developed. In use, a project is broken down to self-contained tasks that are visible on a screen. Once a task has been completed, it can be dragged to the side of the screen. One by one the tasks add up, building a tower that provides visuals of which parts of the project have been completed. A third aspect that the interviews revealed involved features that can support a feeling of meaning at work. For example, one project manager described identifying with his company when seeing beyond-the-work-environment images of his company's products. Thus, the milestone tower additionally connects each completed milestone with photos of the products.

This student project highlighted several features of the experience interviews. The most prevalent was how quickly the interviews led to actionable ideas. The students worked in groups and each group interviewed three participants. The interview data were already sufficient for generating ideas for concepts. The experience categories also proved useful as a tool for communicating within the teams and when presenting concepts to a broader audience, such as clients or other researchers.

When designing for specific work contexts, we found it helpful to better understand how positive experiences of a certain category are structured concretely and within context-specific ways. In this student project we also found that the bottom-up strategy of the open, original version of the experience interview often required larger numbers of interviews to get an overview of experiences. A faster, top-down (theory-driven) strategy can be advanced using the short version of the experience interview, which we discuss next.

Short Version of the Experience Interview

Knowing the experience categories a priori allows one to conduct a more concise version of the experience interview. Rather than asking for any positive experiences, the interviewer can ask only for experiences from a specific category or group of categories. Using this approach, it is possible to collect positive experiences related to preselected experience categories. This is beneficial because the process of collecting experience reports from specific categories as inspiration for design requires less time. Rather than learning about positive experiences in a given context, the main purpose of the interviews is now the familiarization with the context based on previously validated experience categories. For example, if a designer is working in a slightly different context from a past one (e.g., power tools rather than large machines), he/she might want to familiarize him/herself with that given context. If he/she wants to create situations where the user will feel competent and secure, the designer will not be interested in how well the user might work together with others but more on the individual tasks at hand. This means the designer might want to focus on categories such as Rising to a Challenge or Keeping Track of Things rather than Creating Something Together. Another reason might be that the interviewer is inexperienced or there simply is not enough money/time to conduct and analyze the broader full version of the interview.

For example, if the design team wanted to allow users to notice if they had completed a challenging part of a task, they could focus on specific aspects of the respondent's experience. Thus, if the interviewer then focused on experiences in which the interviewee completed a challenge, a typical question would be, "When you think back over the last two weeks, can you think of a positive experience where you felt like you successfully completed something

challenging?” The short version can be analyzed the same way as the full version, as described in Zeiner et al. (2016b) and briefly above. For design processes, the use of the face-to-face interview in combination with the experience interview worksheet (see Figure 1; Appendix A) supports the design processes because the clustered worksheets with experience stories can be used in creative sessions as inspiration for design ideas.

The short version of the experience interview has already been successfully used in several final-year student projects. For example, one student studied positive UX in the smart kitchens, with a focus on millennials (for a full description see Zeiner et al., 2018). This is in line with earlier conducted interviews about positive experiences while cooking that resulted in identified experience categories for cooking/kitchen-related experiences. In working with the student on the project, we felt that, in order to gain a better understanding of the target group and the differences between the millennials and previous generations (Zeiner et al., 2018 included millennials but had participants from a much wider range of generations), the student should focus on a few categories. This approach produced a number of design ideas comparable to the original version of the interviews in the same amount of time. However, because the interviews were more focused, so were the ideas (M. Ackermann, personal communication, June 22, 2016).

Experience Cards

The goal when developing the experience categories was not only the categories themselves but also the development of tools and methods in addressing the needs and opportunities surfaced from the analysis of the related experiences. One of these tools was the Experience Cards that, using the insights of the 17 experience categories, can support the creation and testing of a positive UX. An image of the cards is shown in Figure 3 and the full, printable set of the cards can be found in Appendix B.

Similarly to other card sets, such as Emotion Granularity Cards (Yoon et al., 2013), Need Cards (Hassenzahl et al., 2010), or Wellbeing Determinant cards (Calvo & Peters, 2016), no prior knowledge about theoretical models is necessary in applying the cards, and the preparatory work to use the experience categories is minimal. (However, we have found that an understanding of the differences between UX and usability really helps when using the cards).

To date, we have used the Experience Cards in more than 20 workshops, each with 5–20 participants from small and medium software companies. Feedback from these workshops emphasized that the cards were easy to understand, apply, and use—especially for people with little or no experience regarding UX. One participant mentioned how not having to make the step from abstract descriptions to the context for which she was designing made the experience categories more actionable for her. Compared to working with other frameworks, she felt that she was able to produce more and better ideas because she spent less time trying to understand the framework she was designing with, thus “wasting less time” (B. Bannert, personal communication, July 2, 2016).

One way the cards are used in workshops is to have participants design for positive experiences freely, before introducing the categories. Figure 4 shows photos from a workshop



Figure 3. An overview of the Experience Cards that were developed as an ideation aid for an experience-centric design process. Each card is structured in the same way. The name of the experience category is printed on top of the card, next to its group. Each category is then described using the must have and optional elements. The social index is provided at the bottom of the card, as well as a visualization showing which type of individual the experience category was proportionally experienced (superiors, equals, subordinates, external, alone; see Zeiner et al., 2016b, for a detailed description of the relationship between hierarchies at work and the different experience categories).

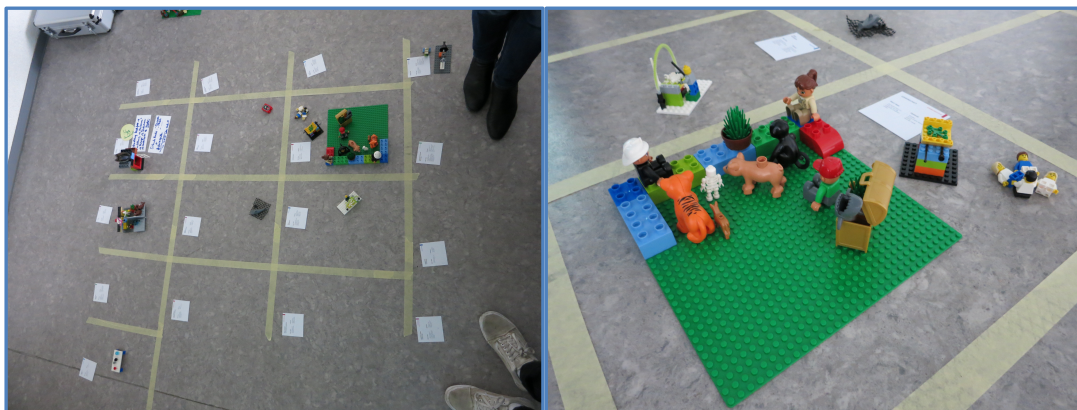


Figure 4. Images from a workshop where we used the Experience Cards to generate new concepts. The left image shows a grid for the 17 experience categories with several Lego models that have been assigned to the experience category they were built for. The right image shows one such model in more detail.

where participants had already designed experiences using Lego bricks. We then introduced the categories and assigned the concepts to the different categories. Participants then went back and developed new concepts for the categories that had been empty in the original design process. In this process, we used the cards to first clarify the categories for participants and to then guide them through their second round of designing experiences by giving them easy access to both the must-have and optional attributes of the category they were designing for.

The Analytical Experience Potential Analysis

When using the experience categories to generate new concepts, the structures within the categories can be compared with the intended activity and used to shape it further. For the analytical experience potential analysis (Laib, Burmester, & Zeiner, 2017), tasks and interactions can be analyzed and compared to the attributes of the experience categories. Designers can ask themselves the following questions:

- Is the situation experienced alone or is there an interaction with other people? Based on the social index, this answer makes some categories more likely than others.
- Where can we find a number of similarities to one or more categories in order to increase the potential for those categories?
- Where is our product or service already creating possibilities for certain categories? Can we “boost” them?
- If a product is already creating possibilities to express appreciation, can we highlight to users that they are showing their appreciation? Or can we make it easier for them to do so?
- Is one category repeatedly facilitated? If so, can we turn the category into a theme for the entire interaction?

By asking these questions and comparing patterns from the work environment with the experience categories, one can either find potential for categories that could be easily generated or potentials for less-likely categories.

Discussion

In the previous subsection, we described the various applications of the experience categories and their use in practical settings. The short version of the experience interviews streamlines the interview process when investigating a domain from which the categories have already been extracted. The Experience Cards are a tool that allows the designer or researcher to apply the categories when designing new positive experiences or as an inspiration tool in workshops. Finally, the experience potential analysis is an approach that formalizes the application of the experience categories when designing new experiences or working with already existing patterns.

In our own work and based on the feedback of workshop participants, the three applications presented here are easy to use. In particular, the Experience Cards are very popular in our workshops. We believe this is partially because any kind of card set allows the designer, developer, or other user of the cards to interact with the concepts behind the cards more easily. For example, other card sets such as the Emotion Granularity Cards (Yoon et al.,

2013), Need Cards (Hassenzahl et al., 2010), or Wellbeing Determinant cards (Calvo & Peters, 2016) are also popular in workshops organized by our research group. However, we believe that the experience categories lend themselves better to this kind of work because they describe concrete activities that are relevant for work.

For application of all cards, a good understanding of the difference between usability and positive UX is necessary (Burmester, Laib, & Zeiner, 2017; Burmester et al., 2015). Furthermore, Desmet and Hassenzahl (2012) pointed out that the most established approach to designing technology is oriented toward a problem-driven model: Technology is seen as the solution to a problem. So, if the way to a certain destination is not apparent, a navigation system is the solution. When designing for positive UX, they proposed possibility-driven design in order to find and use possibilities to design for positive experiences. For example, the application of the experience card *Creating Something Together* requires looking for ways all members of a team to get to know each other, to clarify the shared goals, and to demonstrate the activities and results of the team. Therefore, we created a special workshop to establish the basic understanding of possibility-driven design and design for positive experiences before starting using Experience Cards in design processes (Zeiner, Burmester, Fronemann, & Krüger, 2017).

GENERAL DISCUSSION

This study into positive experiences at work and possible clusters within these experiences was originally motivated by our observation that the research literature focused largely on the consequences of a situation one might experience, such as need fulfillment (e.g., Hassenzahl, 2008; Hassenzahl et al., 2010) and ensuing positive emotions (e.g., Desmet, 2012). This research also has resulted in a number of methods that can be used when designing for positive experiences. However, the abstractness of needs and positive emotions also can feel limiting in the design process. Experience categories describe aspects of the situations that seem to fulfill informants' needs, resulting in positive emotions. This means the categories are intended to fill this gap between experiences and their consequences by giving concrete descriptions of activities that are experienced as positive.

It is important to note that the experience categories approach was developed bottom-up rather than theory-driven. Thus, for a deeper understanding of the theoretical impact, further studies are needed. We plan to analyze how the experience categories are related to other theoretical models of positive UX, such as the need-oriented model of Hassenzahl (2008; Hassenzahl et al., 2010) and the model of positive emotions of Desmet (2012). We suspect that some categories might fulfill only a few needs and are related to specific emotions while others might integrate a variety of needs and emotions.

As with other generative approaches that can be used for design, the experience categories have to be applied appropriately. If, for example, categories are assigned to experiences or designed for only based on the heading rather than the must-have and optional attributes, then it is unlikely that they will result in a design concept that originates in the categories. Or when the experience potential analysis is not performed appropriately and the ideas that are being generated are only recorded as bullet points. While other groups that have

used the categories have not reported this issue, we have come across it when working with student groups (for a discussion of this see, e.g., Laib et al. 2017).

We are continuing to collect experience data from other contexts—such as cooking for the design of smart kitchen equipment and work places using 3D-oriented software tools (computer animation and engineering)—in order to extend the experience category approach. Additional tests and evaluations with small- and medium-sized software enterprises are already underway by employing experience interviews, experience potential analysis, and Experience Cards, as well as these in combination with other UX methods, such as the valence method (Burmester, Mast, Jäger, & Homans, 2010) and UX concept inspiration (Fronemann & Peissner, 2014). The results of these studies will lead to further improvement and validation of the experience category approach. We currently are evaluating whether the must-have and optional elements are more useful for the design process in their concrete form or in a more abstract form.

IMPLICATIONS FOR RESEARCH AND APPLICATION

Approaches such as Hassenzahl's (2008; Hassenzahl et al., 2010) need-oriented definition of UX, the system of positive emotions in product use of Desmet or the approaches inspired by positive psychology as in positive design (Desmet & Pohlmeier, 2013), positive technology (Botella et al., 2012), or positive computing (Calvo & Peters, 2014) focus significantly on basic psychological theories. This includes motivation theory, emotion theory, and theories of positive psychology, such as flow theory (Nakamura & Csikszentmihalyi, 2000), PERMA theory (Seligman, 2011), or broaden and build (Fredrickson, 2004). As an alternative approach, the experience category approach is focused more on describing various types of positive experiences related to a specific context. As a result, they are more comparable to the happiness activities of Lyubomirsky (2007; Lyubomirsky, Sheldon, & Schkade, 2005), which are tested activities that lead to increased well-being. The primary differences between the experience categories approach and the happiness activities are that the experience categories are related to work activities and used to inspire technology design in order to promote positive experiences at work.

Compared to the theory-based approaches, the advantage in using experience categories is that they describe authentic activities relevant for workers leading to positive experiences. Designing on the basis of needs or emotions requires a contextualization and interpretation, for example, what it means to fulfill the need for stimulation at a certain workplace. The process of conducting experience interviews and distilling experience categories from the collected positive experiences outlined in this paper can be used as a research method to describe and understand categories and structures already existing in context-specific, positive experiences.

ENDNOTE

1. The participant codes used here indicate both the data collection batch and the overall interview number within our data set. Thus, PO denotes the source was an online questionnaire, and the number indicates the participant was the 226th interviewed.

REFERENCES

- Bargas-Avila, J. A., & Hornbæk, K. (2011). Old wine in new bottles or novel challenges? A critical analysis of empirical studies of user experience. In *CHI Conference on Human Factors in Computing Systems* (CHI '11; pp. 2689–2698). New York, NY, USA: ACM.
- Bargas-Avila, J., & Hornbæk, K. (2012). Foci and blind spots in user experience research. *Interactions*, 19(6), 24–27.
- Botella, C., Riva, G., Gaggioli, A., Wiederhold, B. K., Alcaniz, M., & Baños, R. M. (2012). The present and future of positive technologies. *CyberPsychology, Behavior, and Social Networking*, 15(2), 78–84.
- Burmester, M., Laib, M., & Zeiner, K. M. (2017). Positive Erlebnisse und Wohlbefinden in Arbeitskontexten durch Gestaltung der Mensch-Computer-Interaktion [Positive experiences and well-being in work contexts through the design of human computer interaction]. In M. Brohm Badry, C. Peifer, & J. M. Greve (Eds.), *Positiv-Psychologische Forschung im deutschsprachigen Raum—State of the Art* (pp. 158–175). Lengerich, Germany: Pabst.
- Burmester, M., Mast, M., Jäger, K., & Homans, H. (2010). Valence method for formative evaluation of user experience. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems* (DIS '10; pp. 364–367). New York, NY, USA: ACM Press.
- Burmester, M., Zeiner, K. M., Laib, M., Hermosa Perrino, C., & Queßeleit, M.-L. (2015). Experience design and positive design as an alternative to classical human factors approaches. In C. Beckmann & T. Gross (Eds.), *INTERACT 2015 Adjunct Proceedings* (pp. 153–160). Bamberg, Germany: University of Bamberg Press.
- Calvo, R. A., & Peters, D. (2014). *Positive computing: Technology for wellbeing and human potential*. Cambridge, MA, USA: MIT Press.
- Calvo, R. A., & Peters, D. (2016). *Wellbeing determinant cards*. Retrieved July 1, 2016, from <http://www.positivecomputing.org/p/projects.html>
- Chui, M., Manyka, J., Bughin, J., Dobbs, R., Roxburgh, C., Sarrazin, H., Sands, G., & Westergren, M. (2012). *The social economy: Unlocking value and productivity through social technologies*. Retrieved January 13, 2016, from www.mckinsey.com
- Csikszentmihalyi, M. (1990). *Flow*. New York, NY, USA: Harper and Row.
- Desmet, P. M. A. (2012). Faces of product pleasure: 25 positive emotions in human product interactions. *International Journal of Design*, 6(2), 1–29.
- Desmet, P. M. A., & Hassenzahl, M. (2012). Towards happiness: Possibility-driven design. In M. Zacarias & J. V. de Oliveira (Eds.), *Human-computer interaction: The agency perspective* (pp. 1–27). New York, NY, USA: Springer.
- Desmet, P. M. A., & Pohlmeier, A. E. (2013). Positive design: An introduction to design for subjective well-being. *International Journal of Design*, 7(3), 5–19.
- Desmet, P. M. A., Pohlmeier, A. E., & Forlizzi, J. (2013). Design for subjective well-being [editorial]. *International Journal of Design*, 7(3), 1–3.
- Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin*, 51(4), 327–358.
- Fredrickson, B. L. (2004). The broaden-and-build theory of positive emotions. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 359(1449), 1367–1378.
- Fredrickson, B. L. (2013). *Love 2.0: How our supreme emotion affects everything we feel, think, do, and become*. New York, NY, USA: Penguin Putnam.
- Fronemann, N., & Peissner, M. (2014). User experience concept exploration: User needs as a source for innovation. In *The 8th Nordic Conference on Human-Computer Interaction* (NordiCHI '14; pp. 727–736). New York, NY, USA: ACM.
- Harbich, S., & Hassenzahl, M. (2008). Beyond task completion in the workplace: Execute, engage, evolve, expand. In C. Peter & R. Beale (Eds.), *Affect and emotion in human-computer interaction* (pp. 154–162). Berlin, Germany: Springer.

- Hassenzahl, M. (2008). User experience (UX): Towards an experiential perspective on product quality. In *Proceedings of the 20th International Conference of the Association Francophone d'Interaction Homme-Machine* (pp. 11–15). New York, NY, USA: ACM.
- Hassenzahl, M. (2010). Experience design: Technology for all the right reasons. *Synthesis Lectures on Human-Centered Informatics*, 3(1), 1–95.
- Hassenzahl, M., Diefenbach, S., & Göritz, A. (2010). Needs, affect, and interactive products: Facets of user experience. *Interacting with Computers*, 22(5), 353–362.
- Hassenzahl, M., Eckoldt, K., Diefenbach, S., Laschke, M., Lenz, E., & Kim, J. (2013). Designing moments of meaning and pleasure: Experience design and happiness understanding experiences. *International Journal of Design*, 7(3), 21–31.
- International Organization for Standardization [ISO]. (2010, March). Ergonomics of human-system interaction - Part 210: Human-centred design for interactive systems (ISO Standards No. 9241 – 210). Geneva, Switzerland: ISO.
- Keltner, D., & Haidt, J. (2003). Approaching awe, a moral, spiritual, and aesthetic emotion. *Cognition and Emotion*, 17(2), 297–314.
- Kohler, K., Niebuhr, S., & Hassenzahl, M. (2007). Stay on the ball! An interaction pattern approach to the engineering of motivation. In C. Baranaukas, P. Palanque, J. Abascal, & S. Diniz Junqueira Barbosa (Eds.), *Human-Computer Interaction – INTERACT 2007 proceedings. Lecture Notes in Computer Science* (Vol. 4662; pp. 519–522). Berlin, Germany: Springer.
- Laib, M., Burmester, M., & Zeiner, K. M. (2017). Erlebnispotenzialanalyse – Mit Systematik zu positiven Erlebnissen [Experience potential analysis: Creating positive experiences systematically]. In S. Hess & H. Fischer (Eds.), *Mensch und Computer 2017 – Usability Professionals*. Regensburg, Germany: Gesellschaft für Informatik e.V. und die German UPA e.V. Retrieved from <https://dl.gi.de/handle/20.500.12116/5773>
- Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *The American Psychologist*, 57(9), 705–717.
- Lu, Y., & Roto, V. (2015). Evoking meaningful experiences at work: A positive design framework for work tools. *Journal of Engineering Design*, 26(4-6), 99–120.
- Lu, Y., & Roto, V. (2016). Design for pride in the workplace. *Psychology of Well-Being*, 6(1), Art. 6.
- Lyubomirsky, S. (2007). *The how of happiness: A scientific approach to getting the life you want*. London, England: Penguin.
- Lyubomirsky, S., Sheldon, K. M., & Schkade, D. (2005). Pursuing happiness: The architecture of sustainable change. *Review of General Psychology*, 9(2), 111–131.
- Mayring, P. (2000). Qualitative content analysis. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 1(2), Art. 20.
- Nakamura, J., & Csikszentmihalyi, M. (2000). The concept of flow. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 89–105). Oxford, England: Oxford University Press.
- Rosso, B. D., Dekas, K. H., & Wrzesniewski, A. (2010). On the meaning of work: A integration and review. *Research in Organizational Behavior*, 30, 91–127.
- Russell, J. A. (2009). Emotion, core affect, and psychological construction. *Cognition & Emotion*, 23(7), 1259–1283.
- Schrepp, M., Held, T., & Laugwitz, B. (2006). The influence of hedonic quality on the attractiveness of user interfaces of business management software. *Interacting with Computers*, 18(5), 1055–1069.
- Seligman, M. E. P. (2011). *Flourish: A visionary new understanding of happiness and well-being*. New York, NY, USA: Free Press.
- Sheldon, K. M., Elliot, A. J., Kim, Y., & Kassir, T. (2001). What is satisfying about satisfying events? Testing 10 candidate psychological needs. *Journal of Personality and Social Psychology*, 80(2), 325–339.
- Tuch, A. N., Trusell, R. N., & Hornbæk, K. (2013). Analyzing users' narratives to understand experience with interactive products. In *Proceedings of the CHI Conference of Human Factors in Computing Systems* (CHI '13; pp. 2079–2088). New York, NY, USA: ACM.

- Tuch, A. N., van Schaik, P., & Hornbæk, K. (2016). Leisure and work, good and bad: The role of activity domain and valence in modeling user experience. *ACM Transactions on Computer–Human Interaction*, 23(6), Art. 35.
- Yoon, J., Desmet, P. M. A., & Pohlmeier, A. E. (2013). Embodied typology of positive emotions: The development of a tool to facilitate emotional granularity in design. In *Proceedings of the 5th International Congress of International Association of Societies of Design Research* (pp. 1195–1206). Tokyo, Japan: International Association of Societies of Design Research.
- Zeiner, K. M., Burmester, M., Fronemann, N., & Krüger, A. E. (2017). Evaluation von Methoden zur Gestaltung positiver User Experience [An evaluation of methods for the design of positive user experience]. In S. Hess & H. Fischer (Eds.), *UP 2017*. Regensburg, Germany: Gesellschaft für Informatik e.V. und die German UPA e.V. Retrieved from <https://dl.gi.de/handle/20.500.12116/5816>
- Zeiner, K. M., Henschel, J., Schippert, K., Haasler, K., Laib, M., & Burmester, M. (2018). Experience categories in specific contexts: Creating positive experiences in smart kitchens. In A. Marcus & W. Wang (Eds.), *DUXU 2018, Lecture Notes in Computer Science* (Vol. 10918; pp. 306–324). Cham, Switzerland: Springer Nature.
- Zeiner, K. M., Laib, M., Schippert, K., & Burmester, M. (2016a). Das Erlebnisinterview – Methode zum Verständnis positiver Erlebnisse [The experience interview: A method for understanding positive experiences]. In S. Hess & H. Fischer (Eds.), *UP 2016*. Aachen, Germany: Gesellschaft für Informatik e.V. und die German UPA e.V. Retrieved from <https://dl.gi.de/handle/20.500.12116/5448>
- Zeiner, K. M., Laib, M., Schippert, K., & Burmester, M. (2016b). Identifying experience categories to design for positive experiences with technology at work. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (pp. 3013–3020). New York, NY, USA: ACM.

Authors' Note

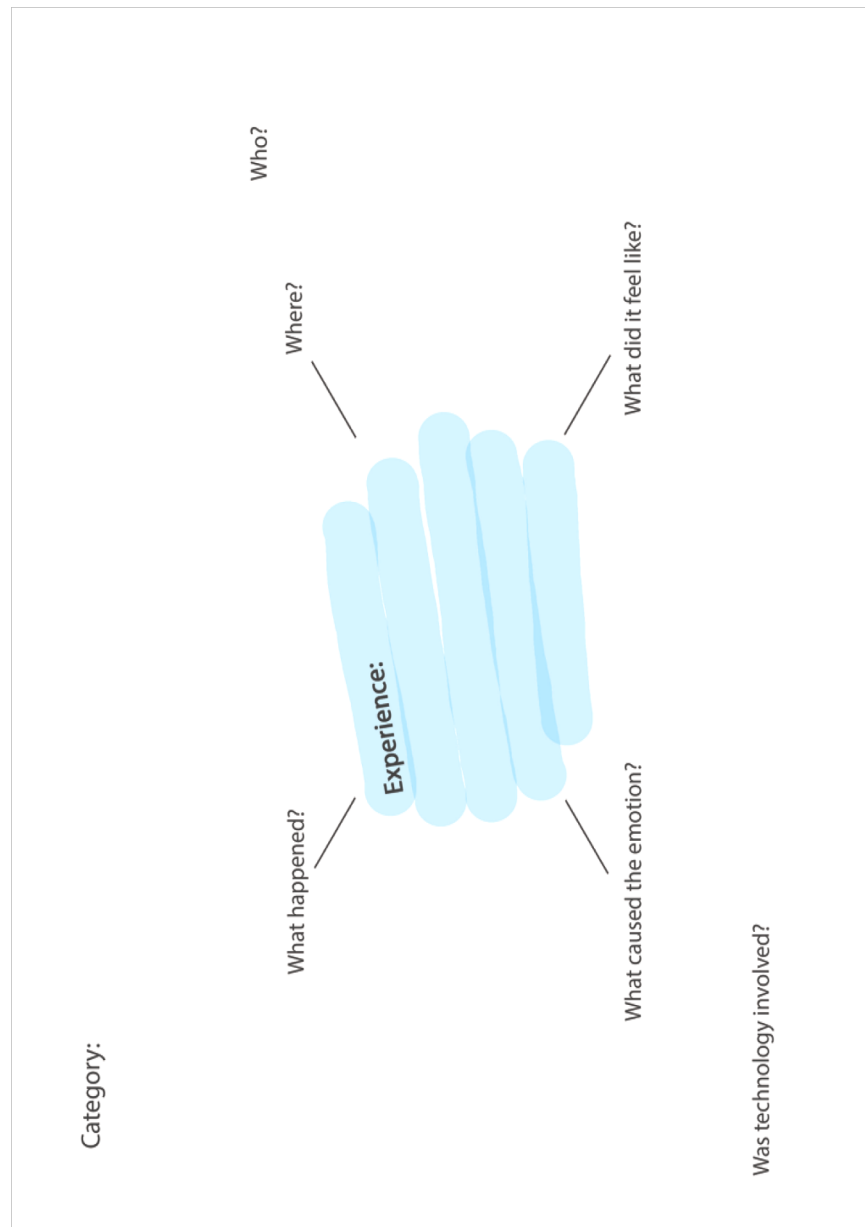
This work was conducted as part of the project “Design4Xperience” that was funded by the German Federal Ministry for Economic Affairs and Energy as part of the initiative “Einfach intuitiv – Usability für den Mittelstand. The Experience Cards shown in Figure 3 were designed by Julian Henschel. The design concepts described above were developed by Meike Remiger, Anja Rittmann, Yen Nguyen, Felix Bell, Florian Frick, and Alexander König.

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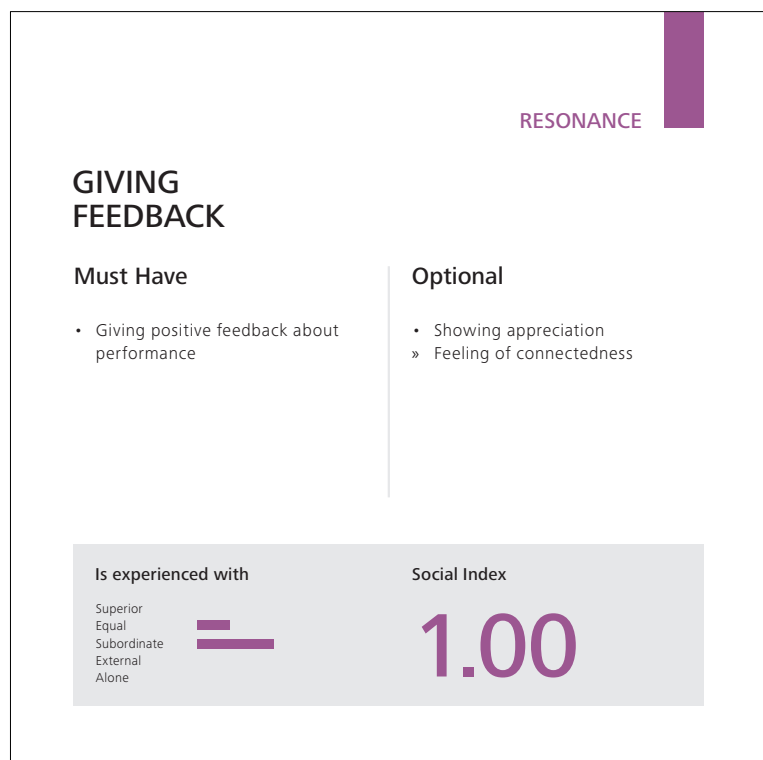
Appendix A

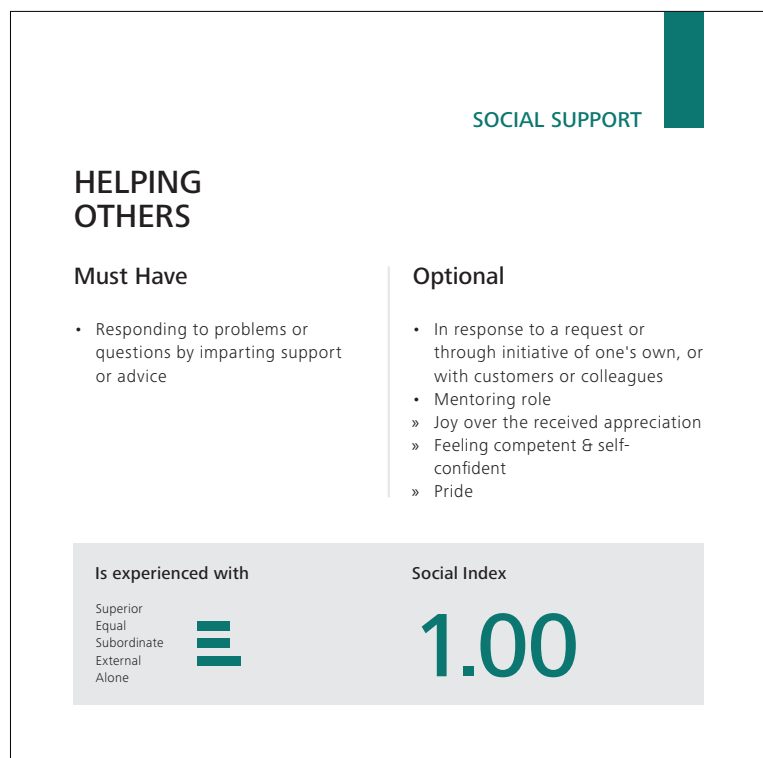
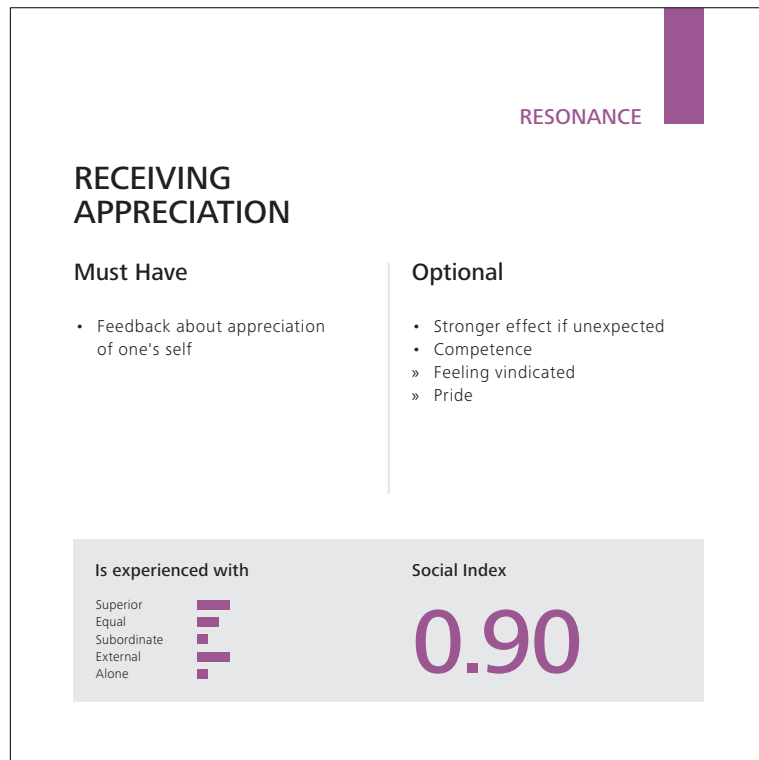
This interview worksheet can be printed and used for interviews in multiple domains and work environments. It allows the interviewer to work collaboratively with the interviewee in assembling the fullest possible picture of the experience.

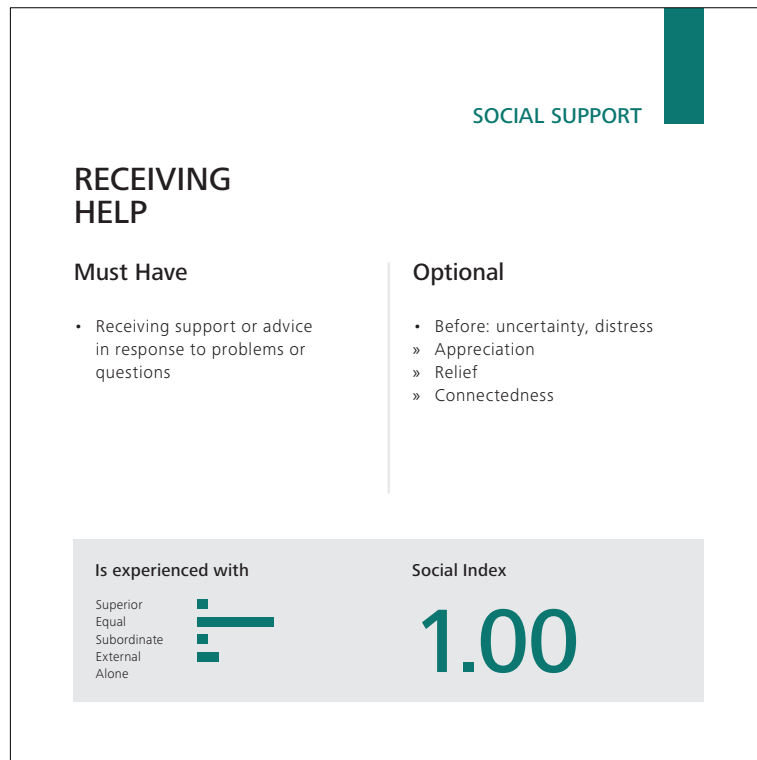


Appendix B

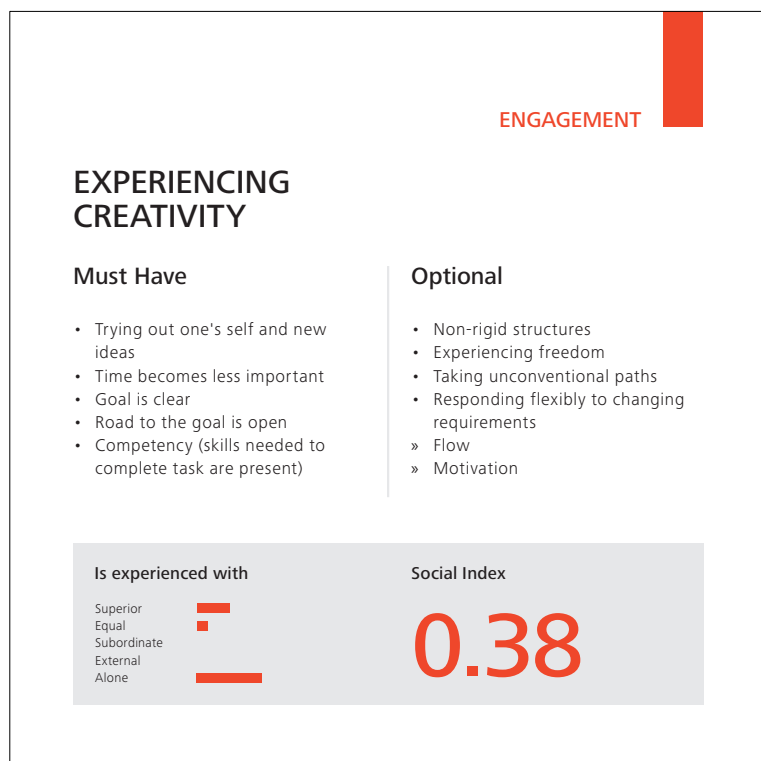
This Experience Cards set can be printed and used as described in the Applications section of this article.





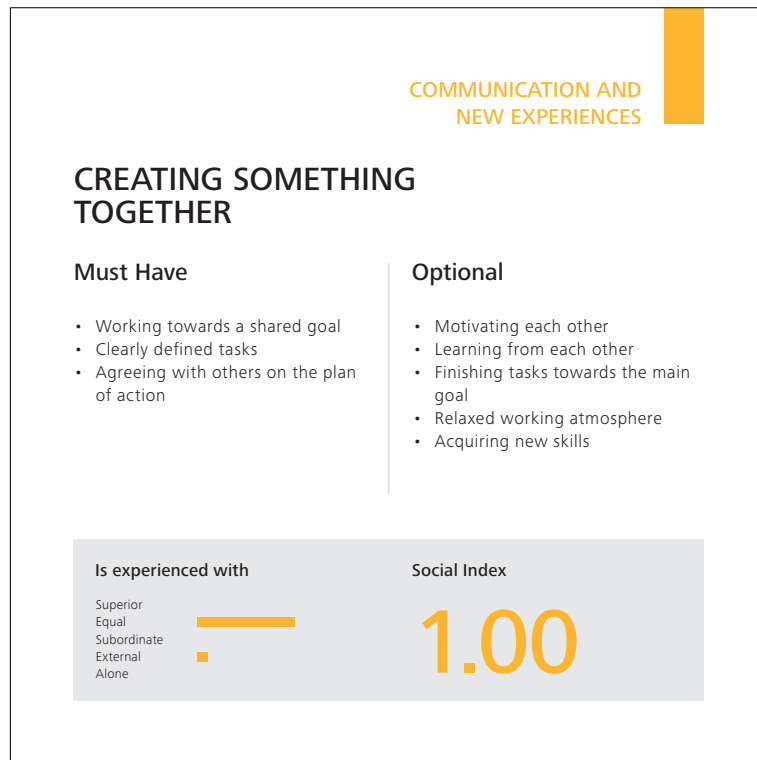


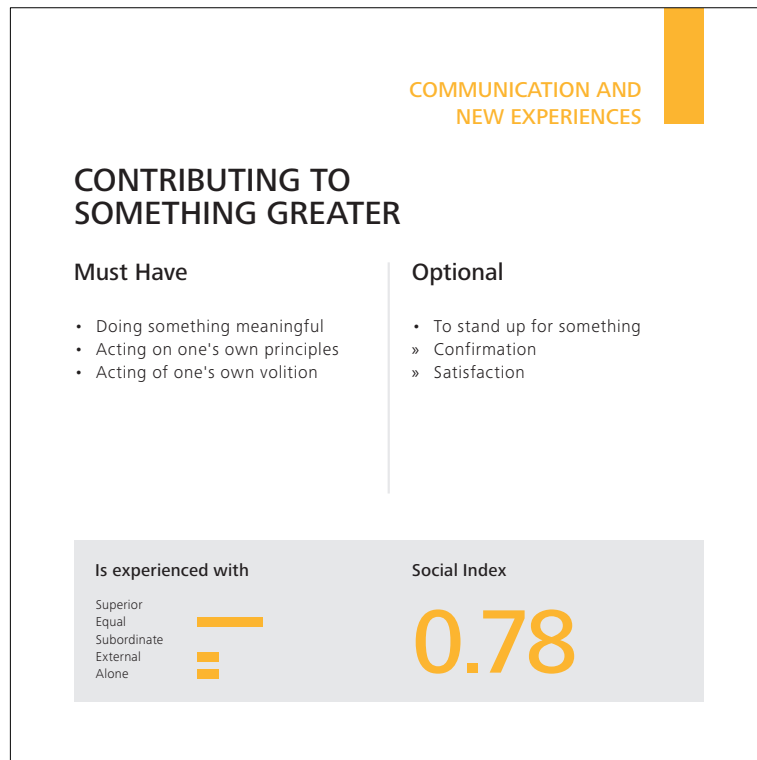












A CASE STUDY ON GAMIFIED INTERVENTIONS FOR TEAM COHESION IN FACTORY WORK

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Abstract: *In this article, we aim to provide insights into the design and implementation of game elements for teamwork on the work floor and to study their effect. Inventing games to break monotonous jobs is a long-standing practice, yet conscious implementation of motivational elements of games at work is a recent phenomenon. Generally, gamification is used to enhance individual performance; it may be effective in enhancing teamwork as well. We developed game elements aimed at team cohesion and examined the effect of two gamified interventions (team performance feedback and personal profiles) on team cohesion in a factory. Results suggest that the interventions mainly raised attention toward the aspects of the work that were explicitly addressed. Team performance feedback led to increased task commitment and perceived team performance, while personal profiles increased nonwork-related conversations among team members. We conclude with lessons learned regarding the development and study of gamified interventions for teams on the work floor.*

Keywords: *gamification, team cohesion, applied design research, factory operators.*



INTRODUCTION

Gaming at work is not new. Factory workers in the 1950s (Roy, 1959) and '70s (Burawoy, 1979) were observed relieving stress and breaking the monotony of their jobs by inventing game-like motivations for their work. This increased the workers' satisfaction as well as their productivity. Roy (1959) described "a game of work" (p. 160) that made the operation of an industrial punching machine more satisfying, with rules such as "As soon as I finish a thousand green ones, I'll click some brown ones" (p. 161). Moreover, he suggested that informal noninstrumental interaction (e.g., small talk) is a key source of job satisfaction for monotonous operating jobs. Years later, Burawoy (1979) observed the same machine production factory. He described similar game-like strategies by workers to keep their jobs interesting, including game-like motivations for reaching production quotas. This motivation led to a high work pace and sometimes to operators clashing with management to defend the conditions for their productivity.

Factory jobs often lack the characteristics known to increase employees' performance, motivation, and satisfaction, as described by the job characteristics model (Hackman & Oldham, 1980): skill variety, task identity, task significance, autonomy, and job feedback. Nonetheless the operators in the above-described factory exhibited self-implemented game-like engagement with their jobs. The workers transported themselves from a monotonous and tedious work experience toward a more fulfilling game experience, which can be defined as "the voluntary attempt to overcome unnecessary obstacles" (Suits, 1978, p. 54). Roy's (1959) game of work and informal, noninstrumental conversations with colleagues are good examples of this.

Transporting a user experience from a nongame experience to a more game-like (or gameful) experience is referred to as gamification (Green, Brock, & Kaufman, 2004; Huotari & Hamari, 2012; Visch, Vegt, Anderiesen, & van der Kooij, 2013). Instead of leaving gamification solely to the workers, the current trend in business is to explicitly apply game elements (Deterring, Dixon, Khaled, & Nacke, 2011). Currently, most applications of gamification rely on game-like incentive mechanisms with points, badges, and leaderboards (Hamari, Koivisto, & Sarsa, 2014). However, when taking game design as an inspiration for nongame contexts, we find many more opportunities for making factory work feel like a game. According to McGonigal (2011, p. 346), games are the single best research laboratory for discovering new ways to reliably and efficiently engineer optimal human experiences. For example, game-like metaphors or challenges that are developed by the game industry often are used to improve employees' work experience (Berendsen, 2014; Hsieh, 2010). By introducing motivational elements found in games, workers may become more satisfied with—and motivated toward—their jobs (Mollick & Werbach, 2014), typically leading to better performance.

Game Elements for Team Cohesion

Although many games are individual and competitive, they often rely on collaboration and teamwork as well (Salen & Zimmerman, 2005). For example, many sports games contain competition between teams, and in massively multiplayer online games, players form teams to overcome challenges and defeat virtual opponents. The elements that motivate players to

invest much effort in achieving collective goals, such as defeating opponents or completing difficult challenges, might also be applicable for operating teams in a factory. Providing a game-like goal is one way to achieve this. Yet games contain many other elements that stimulate collaboration, such as roles, discussion forums, and the exchange of resources (Warmelink, et al. 2017). Hence, by analyzing the teamwork process and selecting the appropriate game elements, individual motivation for collective performance may increase.

Organizational psychology provides inspiration for the design of game elements for teamwork. The literature suggests many conditions for high team performance (Ilgen, Hollenbeck, Johnson, & Jundt, 2005). Among other things, interdependence and cohesion frequently are mentioned in relation to team performance (Beal, Burke, McLendon, & Cohen, 2003). Interdependence is a precondition for individuals working as a team (Brounstein, 2002). The extent to which team members feel interdependent correlates positively with the extent to which they collaborate (Frenkel & Sanders, 2007), which in turn positively affects team performance. Team cohesion reflects the extent to which team members feel part of the group. Literature on team cohesion suggests several factors that lead to stronger cohesion: commitment to goals and tasks of the team (i.e., task cohesion), interpersonal interaction, and individual attraction to the team (i.e., social cohesion; Kozlowski & Ilgen, 2006). Interdependence, task cohesion, and social cohesion provide a fruitful starting point for developing game elements for team cohesion.

Game Design Interventions at a Factory

This article presents a case study of designing, implementing, and evaluating game design interventions for team cohesion within production teams at a strip galvanizing plant (Wuppermann Steel Netherlands). At this factory, unprocessed coils of sheet steel come in and shiny, coated, and cut coils of sheet steel come out. The production process is largely automated and optimized. Throughout their shifts, operators mainly sit behind screens, monitoring and maintaining the production line. Consequently, keeping the operators engaged in their jobs has become the major concern of the management. Additionally, the feeling of working as a team is low because the operators are divided among various sections of the plant. In this context, enhancing interdependence and team cohesion through game elements may be helpful in increasing the operators' engagement with their jobs.

Three years ago, a process was initiated in one production department to increase workers' engagement with team performance. In collaboration with a serious game design company (&RANJ, the Netherlands), LED displays with production figures (e.g., tons of processed steel) were replaced by touch screens in the factory hall and canteen (see Figure 1). These screens displayed a dashboard with real-time game-like infographics about the operating team's key performance indicators (KPIs) and click-through pages with detailed information about the KPIs. As a result of the display, according to the managers, the KPIs became a more dominant topic of discussion among the operators of that department.

In this paper, we describe two studies of the effect of new game design interventions for team cohesion in two separate production departments of the factory (galvanizing and cutting). In the galvanizing department, interactive personal profile pages for all workers within that department were added to the already-present screens. In the cutting department, the still-present LED display was replaced with a touch screen displaying gamified performance information in

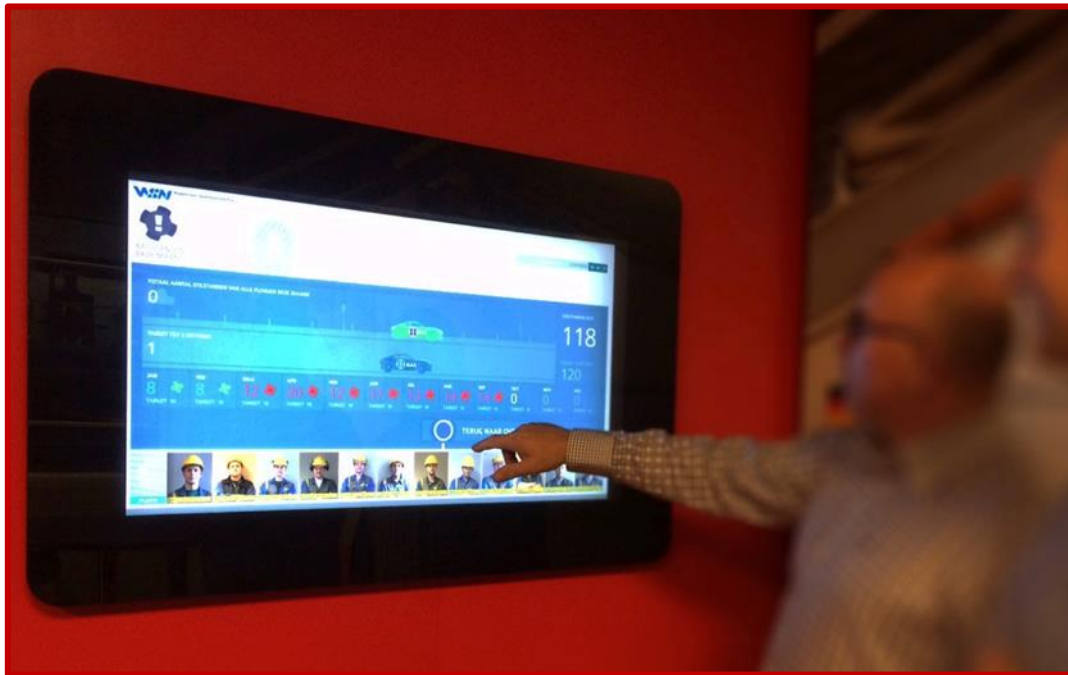


Figure 1. The touch screen in the canteen displays the performance (upper racing car) and target goal (bottom racing car) of the team at the galvanizing department, intending to engage team members regarding their shared output.

the factory hall. In addition to measuring the effect of game design interventions, we aimed to discover general guidelines for the design and implementation of game elements in nongame teamwork contexts. We therefore describe the theoretical as well as practical considerations within the design process. In the following section, we first introduce our perspective on gamification, then summarize organizational psychology literature about teamwork, concluding with the theoretical framework that served as the basis for the interventions. Next, the context of the factory and perspective of the operators is addressed. The theoretical framework and user/context factors were used to inform the design process as well as to form hypotheses regarding the intervention studies.

THEORETICAL BACKGROUND

Gamification

The rise of computer games has increased the interest in consciously implementing games as aspects of work processes at companies (Edery & Mollick, 2009; Reeves & Read, 2009). Gamification, the use of game elements in nongame contexts (Deterding et al., 2011), is increasingly applied and investigated in business environments (Reiners & Wood, 2015). Currently, gamification is operationalized primarily as game-like incentive mechanisms (Hamari et al., 2014). For example, participants could gain points for tagging photos (Mekler, Brühlmann, Opwis, & Tuch, 2013), badges could be earned for specific activities at a peer-to-peer trading service (Hamari, 2013), and sales achievements would be displayed as a basketball

game (Mollick & Rothbard, 2013). These implementations demonstrated marginal positive effects on productivity, effort, and job satisfaction that, to a large extent, depended on the compliance of the users.

However, as Bogost (2014) critically claimed, current gamifications seem to exploit mainly the motivational elements of games instead of inherently motivating employees for particular tasks. Rather than just adding game-like incentive mechanisms, we suggest to gamify a worker's experience of his/her job. Research on self-determination in games (e.g., Ryan, Rigby, & Przybylski, 2006) demonstrates that successful games derive their motivational power by tapping into basic psychological needs of the player. As a result, gamers shift more easily toward internalized and intrinsic motivational states, which are often related to increased commitment and performance in work contexts (Ryan & Deci, 2000).

This does not mean, however, that gamification should be aimed solely at intrinsic motivation (e.g., simply enjoying an activity). Instead, gamification should provide a variation of motivators, intrinsic as well as extrinsic (e.g., enjoying the outcome of an activity) because different player types can experience the same affordances differently (Huotari & Hamari, 2012). A good example of combining intrinsic and extrinsic elements is the coffee shop game that supports self-managing service desk teams at a banking company to organize their work (Berendsen, 2014). Their work activities were communicated through a coffee shop metaphor, thereby strengthening the employees' understanding of their activities. Beyond increasing their enjoyment in their work, the process also raised motivation for extrinsic elements, such as acquisition and sales. Another example is a multiple-choice quiz that encourages home workers of a service desk to get in touch with each other (Hsieh, 2010). In the quiz, participants were extrinsically motivated (i.e., wanting to win) toward getting to know colleagues better and, simultaneously, the activity of getting to know colleagues better in the online chat area was inherently satisfying.

The coffee shop game (Berendsen, 2014) was added as a gamification layer on top of the nongame teamwork situation, whereas the multiple-choice quiz (Hsieh, 2010) was integrated into the already available online communication functionalities for home workers and their profile information. These examples demonstrate that gamification can involve either adding a game layer on top of the real teamwork or adding some game elements and/or making existing nongame elements more game-like. When developing game design interventions for production teams, we took both strategies into account. Note that the coffee shop game and quiz about colleagues were aimed at teamwork, whereas most gamification literature is concerned with individual motivation for individual performance. Thus, to inform our design process of game elements for teamwork, organizational psychology literature was reviewed.

Conditions for High Team Performance

In organizational psychology, team performance has been investigated extensively. Much of the work emphasizes conditions for high team performance (see, e.g., Ilgen et al., 2005) because conditions (e.g., organizational impact, defined focus, knowledge, and skills) show more significant effects than process variables (e.g., conflict management and communication; McGrath, 1997). Team performance is defined through several dimensions: effectiveness, efficiency, learning and personal growth, and team member satisfaction (MacBryde &

Mendibil, 2003). Of course, the organizational goal of operating teams is to be effective and efficient; yet without learning and team member satisfaction, teamwork is hard to sustain.

Following these dimensions, Castka, Bamber, Sharp, and Belohoubek (2001) suggested a combination of system factors and human factors for developing high performance teams. One of the system factors is information about performance measures, which directly relates to the real-time performance feedback on the KPI screens in our study. Regarding the application of direct performance feedback, research is not well developed yet, although current technology systems have the potential to assess team member behavior and performance in real-time (Kozlowski, Grand, Baard, & Pearce, 2015). The available literature suggests that individual feedback raises a team member's attention and effort for individual performance and team feedback improves team performance (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004). Additionally, teams tend to focus mainly on using measures that are used for providing rewards, ignoring other measures (Mendibil & MacBryde, 2006). Hence, for example, rewarding team productivity may lead to undesirable neglect of side-tasks, such as cleaning. Moreover, when employees are rewarded individually, implementing a team performance measurement system is found to be less effective for the same reason.

When projecting these insights onto our case, the galvanizing factory seems mainly organized to support the system factors. The production teams are at the heart of the production process: They have a clear goal, the distance with the management is small, and the KPI screens provide real-time information about the team performance. Yet the support of human factors could be improved, such as recognition for each operator's individual contribution (Zigon, 1997) and the knowledge and skills to work at every section of the production line. Hence, our study aimed to improve human factors.

Team Cohesion

To specify human factors in relation to team performance, we tapped into literature on team cohesion. Team cohesion is the most extensively investigated construct underlying team processes (Grossman, 2014; Kozlowski & Ilgen, 2006). More cohesive work groups displayed greater amounts of courtesy (Kidwell, Mossholder, & Bennett, 1997), efficiency (Beal et al., 2003), viability (Chang & Bordia, 2001; Mello & Delise, 2015), coworker assistance (Frenkel & Sanders, 2007), and satisfaction (Voulgari & Komis, 2015). Team cohesion generally shows stronger correlations with efficiency (e.g., completion time) than with effectiveness measures (e.g., task completion; Beal et al., 2003). This is explained by the fact that team cohesion includes task cohesion (i.e., commitment to the team's goals and tasks) and social cohesion (i.e., interpersonal interaction and personal attraction to the team; Kozlowski & Ilgen, 2006). Task cohesion increases team performance (Carless & De Paola, 2000; Chang & Bordia, 2001), yet social cohesion is more related to collaborative behavior (Beal et al., 2003) and the viability of a team (Chang & Bordia, 2001; Mello & Delise, 2015). However, social cohesion could in some situations deteriorate team performance due to the pressure to conform (Rovio, Eskola, Kozub, Duda, & Lintunen, 2009).

Techniques for enhancing team cohesion in favor of team performance are not well developed yet (Grossman, 2014; Kozlowski & Bell, 2013). Team performance itself was not found to directly influence team cohesion; instead, cohesion reinforces performance (Chang & Bordia, 2001). A recent study on team cohesion in massively multiplayer online games

(Voulgari & Komis, 2015) suggested social and achievement-related forces. Among other things, social forces entail a player identifying with the interests of group members and social interactions. Examples of achievement-related forces are successful cooperation, relevancy of group goals to individual goals, and linking individual success to group success. This relates to workflow interdependence, which is an important moderator for the cohesion–performance relationship (Beal et al., 2003; Gully, Devine, & Whitney, 2012). Workers help each other more when tasks are more interdependent (Frenkel & Sanders, 2007), and when they help each other more, they have a stronger desire to continue working together if the team performs well (Spataro, Pettit, Sauer, & Lount, 2014).

In conclusion, strengthening task cohesion (i.e., targeting behaviors that enhance commitment to the group task) seems the most important factor for improving teamwork (Carless & De Paola, 2000). Yet stimulating social cohesion (i.e., attraction to the group and interpersonal interaction) and emphasizing interdependence may improve team performance in the long-term (see Figure 2).

Research Framework

As explained in the Introduction, the operating team's performance had become a key factor for the factory's output because the automated production process had been largely perfected. Team cohesion and interdependence are key factors for achieving high team performance, according to the literature. Hence, we developed game elements that were meant to influence the factors that enhance team cohesion and interdependence. Figure 3 shows how the game elements on the interactive screens were based on the theoretical model presented in Figure 2. Introducing real-time feedback via the KPIs was expected to increase task cohesion within the production teams. To increase social cohesion, game elements were aimed at stimulating interpersonal interaction. More specifically, personal information (e.g., birthdays, hobbies, and interests) was expected to stimulate informal conversations. By showing one's contribution to the team, we anticipated an increase in perceived interdependence. One's personal information and contribution to the team would be displayed in one's own profile page.

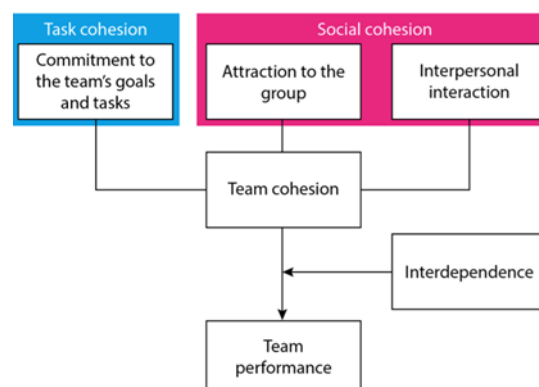


Figure 2. The theoretical model: Team cohesion and interdependence positively affect team performance, and team cohesion consists of task- and social cohesion.

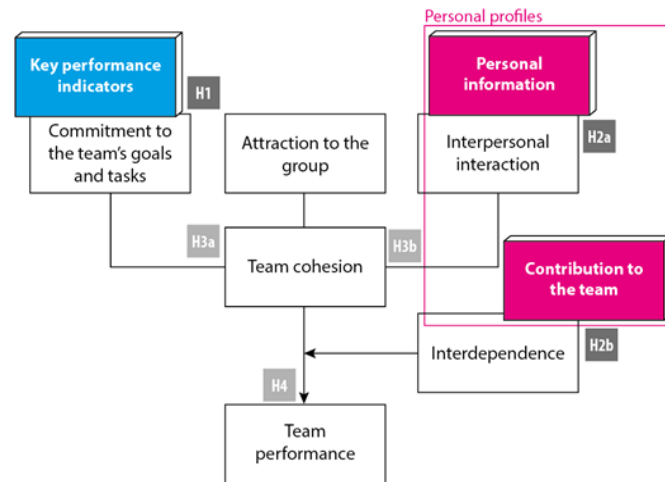


Figure 3. Our research framework: Game elements (colored boxes) were introduced that addressed aspects of task cohesion, social cohesion, and interdependence. We primarily expected to find a direct effect (H1, H2a, and H2b).

As a first step in investigating game elements for team cohesion, the present study was aimed at measuring the direct effect of introducing game elements. That is, the effect of real-time KPI feedback on commitment to the team's goals and tasks (H1 in Figure 3), and the effect of personal profiles on interpersonal interaction (H2a) and interdependence (H2b). Of secondary interest was the effect on team cohesion (H3a & H3b) and performance (H4).

USER/CONTEXT ANALYSIS

The decision to translate KPIs, personal information, and contribution to the team into game elements on the screens was grounded not only in the literature, but also on a review of human factors and system factors at the galvanizing plant. System factors such as production line, task division, and KPIs served as inputs for the design of KPI graphics and the workers' contributions to the team in the personal profile pages. Through exploratory talks with operators from various sections of the production line, we gained insights into their experiences of human factors (e.g., job motivation, team cohesion and interdependence) prior to the intervention. Thus, the game elements for personal information and contribution to the team were selected on the basis of these talks.

System Factors: Production Line, Task Division, and KPIs

As Figure 4 shows, the production line of the galvanizing plant consists of two departments based in separate halls: galvanizing and cutting. In the galvanizing department, unprocessed coils of sheet steel are galvanized, flattened, and sometimes chemically processed. The processed steel is coiled up again and then moves to the cutting department where the processed coils are cut into prescribed sizes and then packaged for shipping. This process runs continuously, 24 hours a day and 6 days a week. In each department, a team of operators runs the line for 8 hours; thus there are 3 shifts a day.

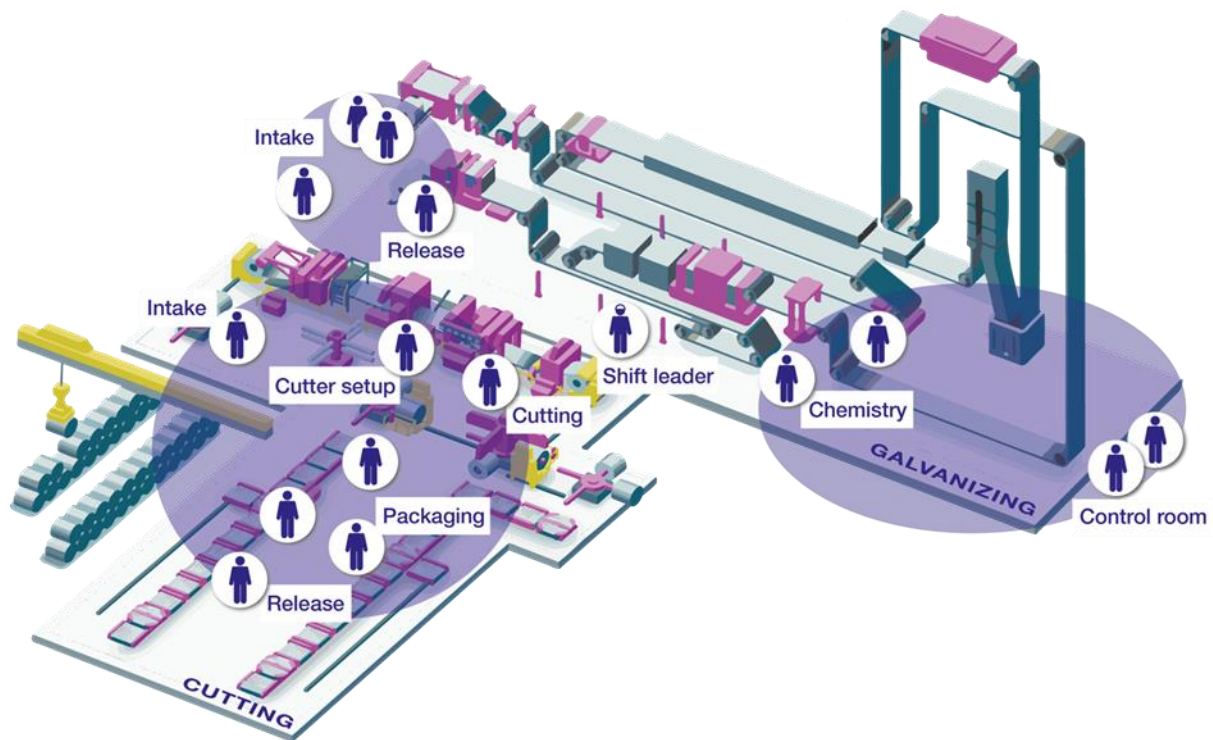


Figure 4. A map of the two production halls of the strip galvanizing plant, with the galvanizing department (top-right) and cutting department (bottom-left). Each department consists of sections (labeled) with a certain number of operators (human icons). Galvanizing operators experience separation within the team (two purple circles at the top), cutting operators do not feel this separation (bottom purple circle).

The galvanizing department is divided into four sections: intake, release, chemistry, and the control room. At the intake section, operators position the unprocessed coils and weld them to the ongoing production line. Galvanization takes place in a tower at the other side of the hall, next to the control room. Control room operators are responsible for the speed of the line and the galvanization process in the tower. Before and after galvanization, several chemical processes can take place. Chemistry operators are responsible for the proper set of chemicals. At the end of the line, release operators verify the quality of the galvanized steel and make sure that the processed coils are transported to the cutting department. Most operating positions are equipped with several monitors and a button panel.

The galvanizing teams are assessed on four KPIs: production, first-time right, standstills, and days without injuries. Production refers to the tonnage of steel that each team processes, and first-time right reflects an efficiency measure, referring to perfect processing without any loss of material and time. Reducing the number of standstills is a major concern of the operators. A standstill happens when the line stops or when the steel sheet rips. This not only leads to delay, but also a financial loss because all the steel currently in the line needs to be replaced after a standstill. For each KPI, the management provides targets that the teams need to meet. Depending on the shift leader, a team may prioritize KPIs differently. One team might be focused more on reaching maximal production, whereas another team is equally concerned with leaving a clean workplace to avoid injuries. Two touch screens display real-time infographics about the output. (Figure 5 & Figure 6 show two example pages that were already

on the screens before our intervention.) One screen is placed in the canteen and one in the hall near the intake section.

The cutting department is divided into five sections: intake, cutter setup, cutting, packaging, and release. At the intake section, the galvanized coils are accepted from the galvanized line and stored. This section is largely automated and thus not always manned. The operator at the cutter setup is responsible for the knives that cut the coils, while another operator oversees the cutting. Packaging and release operators assure that the coils are readied for shipping and are shipped. The operators in the cutting department are not dominated by a continuously running production line, yet they do have production targets. Next to reaching production targets, they are concerned with client satisfaction. Coils need to be cut neatly, without deforming the coil or fraying the edges. Clients are asked to give feedback on the quality at delivery. The feedback results are all available in the factory's data system that could be shown through graphics on the screen.

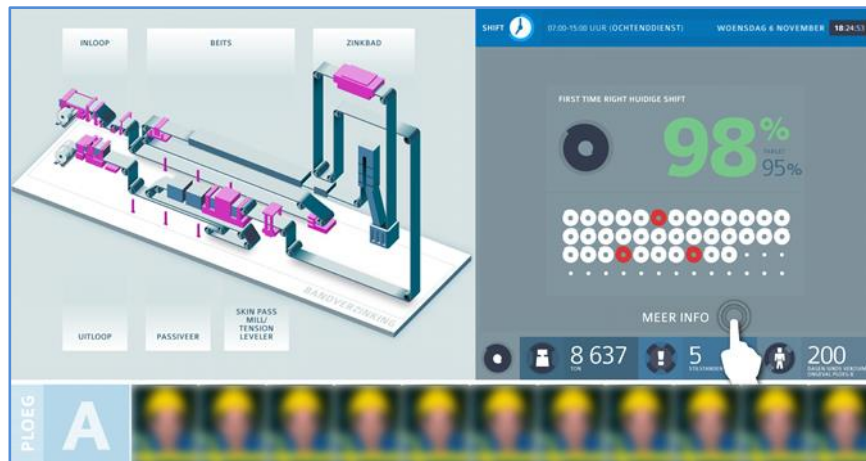


Figure 5. Overview page of the screen at the galvanizing department: production line (left), real-time key production indicators (KPIs, right), and photos of the team currently on duty (bottom).



Figure 6. Detailed information about production targets on the screen of the galvanizing department. A full ship indicates that the target is met. In the top-left, tonnage of steel produced in a particular week, the ship on the top-right depicts the monthly production, and the bottom ship shows the yearly production.

Human Factors: Team Cohesion and Interdependence

In the exploratory talks with the coworkers, most galvanizing operators mentioned the physical separation within the team operating the galvanizing department. They stated that the team consists of “islands.” In Figure 4, these islands are identified. Thus, the operators at intake and release are quite distant from the control room; the chemists work in the middle of the hall. The operators explained that the lack of physical proximity cuts the team in half. Moreover, even though intake and release operators work near each other, they do not often speak to their coworkers because the release operator needs to continuously concentrate on the line. The operators use handheld transceivers to communicate. Yet if everything runs properly, there is no communication so that the radio line is available for emergencies.

In addition to the physical separation and rare communication, differences in tasks and hierarchy separate the operators. For example, control room operators control the speed of the processing line, thereby being responsible for the production target, whereas intake operators need to insert and weld the coils properly to reach the first-time right target. When the line runs fast, intake operators need to work harder to keep up and make no mistakes. If they fall behind, they contact the control room to slow down the line. Consequently, control room operators admitted that they sometimes complain about the slow intake operators, while intake operators sometimes complain about the control room operators pushing them too much. Moreover, there are hierarchical differences between operators. New employees generally start at intake and work their way up toward becoming a control room operator. Ideally, all operators should be able to take over at every position; yet due to differences in education and experience, chemistry and control room operators hardly ever work at the intake or release sections.

Overall, the continuous production line dictates the galvanizing operators’ work experience. In the exploratory chats, workers expressed their main motivation as keeping the line running; however, the physical separation, as mentioned regularly, can be expected to be obstacles to a feeling of interdependence and being part of a team. Thus, we researchers had to temper our expectations regarding increasing interdependence and team cohesion at the galvanizing department. Yet some operators expressed interest in more personal contact with colleagues. Hence, game elements for social cohesion could be a valuable intervention at the galvanizing department.

The cutting department would probably benefit most from game elements for task cohesion, as it contains fewer obstacles for social cohesion. The teams work in closer proximity and they replace each other on tasks more often. Hence, we expected that interdependence and social cohesion was already felt more strongly by the cutting operators. Consequently, introducing real-time feedback on KPIs, thereby raising task cohesion, was expected to have a stronger effect on overall team cohesion and performance than raising social cohesion through personal profiles.

STUDY DESIGN

Following the different situations in the two departments, we executed two separate intervention studies, with hypotheses regarding the potential outcome as described by Figure 3. Study 1 examined the effect of introducing a new screen with game-like KPI infographics on the commitment to team goals and team tasks (H1) in the cutting department. Simultaneously, Study

2 was executed in the galvanizing department, where the already present KPI screens were updated with improved graphics, including personal profile pages. Thus Study 2 examined the effect of additional gamified personal profiles on informal conversations (H2a) and interdependence (H2b).

Page Design

Figure 7 shows the pages and features on the screens for both studies. The development of pages for the new screen in Study 1 was a straightforward process. The company managers provided KPIs and game designers at &RANJ translated these into game-like infographics. The development of game elements for personal information and one's contribution to the team for Study 2 required a more elaborate approach. Based on the talks with operators, we selected the features that are presented below. Moreover, pop-up statements about colleagues (described below) were introduced to stimulate informal conversation. The following sections describe the pages and features in more detail."

Intervention 1: KPI Screen in the Cutting Department

The new screen for the cutting department consists of an overview page and three "more information" pages (see Figure 7). The overview page, shown in Figure 8, contains a static image of the production line on the left, real-time KPI data on the right, and photos of the team currently on duty at the bottom. The KPI information is presented in a carousel that automatically shifts

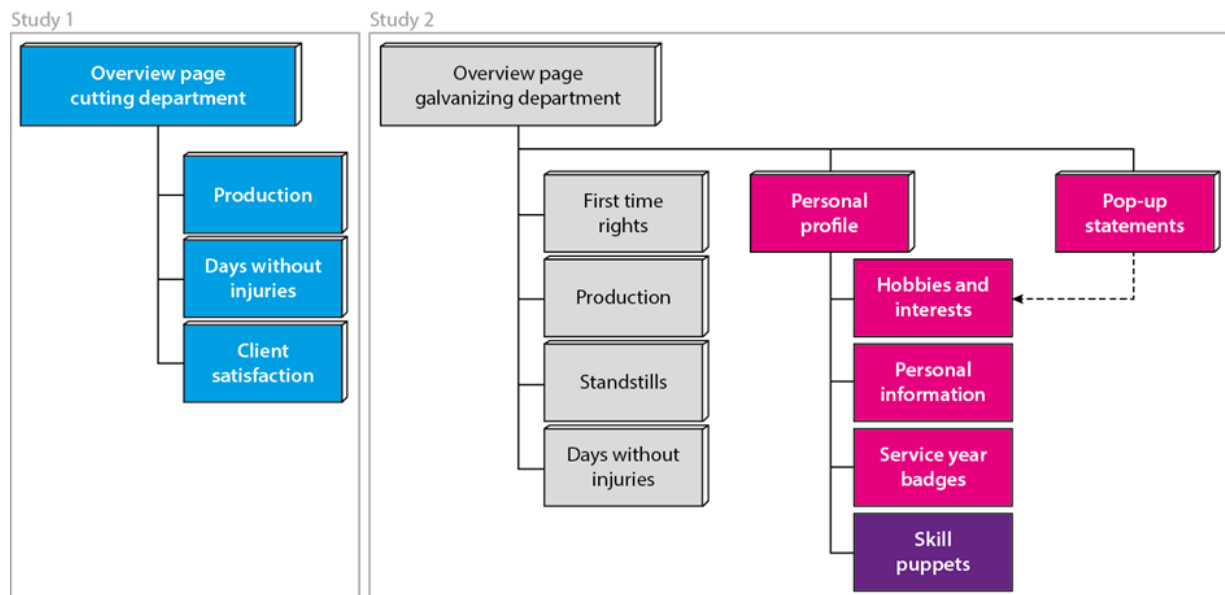


Figure 7. Content of the screens for both intervention studies. New pages (blue) were created to stimulate task cohesion in the cutting department. For workers in the galvanizing department, new pages and features (pink) were added to stimulate informal conversations and to increase interdependence (purple). The gray pages presented already existing information. Pop-up statements are statements about hobbies and interests of some of the operators that pop up on the screen at the end of each shift. The answers feed into the hobbies and interests of the particular operator's profile page. Skill operator figures show an operator's trained skills per section of the production line.

between KPIs. In Figure 8, the number of tons and coils shows the team's current production. When clicking on it, details regarding the daily, monthly, and yearly targets appear in the shape of ships that fill up with progress, similar to the graphics for the galvanizing department (see Figure 6). Days without injuries is represented by a number. The detail page shows the results of the past months and two racing cars represent the team's current performance and their target (similar to Figure 1). Regarding client satisfaction, the overview page displays the overall score through a meter (as in Figure 9) and the five clients that they produce the most steel for. The detail page lists the separate assessment criteria, including the number of complaints represented by an icon (Figure 9 on the left).

The screen was installed next to the entrance of the hall where operators regularly walk in and out. In this way, the cutting operators could have a regular look at the overview page.

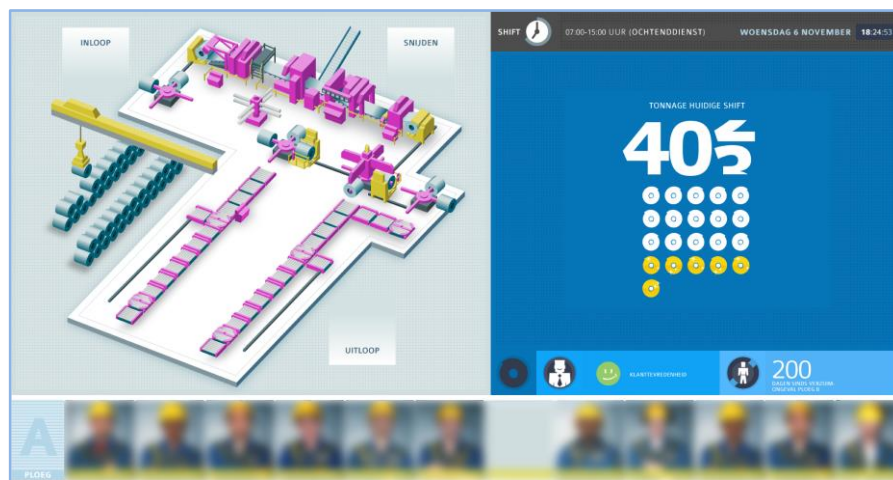


Figure 8. Overview page on the new screen at the cutting department: production line (left), The key production indicator (KPI) carousel (right) that rotates through information every 30 seconds, and the current team (bottom).

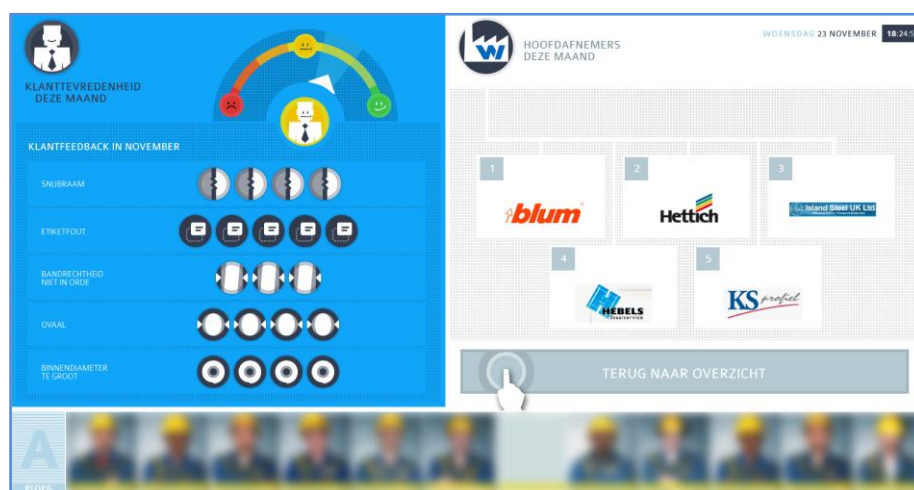


Figure 9. Client satisfaction page on the new key production indicators (KPIs) screen for the cutting department.

Intervention 2: Personal Profile Pages

Additional to the already existing overview page and four KPI pages at the galvanizing department, two new types of pages were added to the screens: personal profiles (Figure 10) and pop-up statements (Figure 11). For each operator, a personal profile page was created containing personal information and one's trained skills per section of the production line, accessible by clicking on the operator's image at the bottom of the screen. The profile pages contain date of birth, place of residence, hobbies and interests, service years, and role within the team. The service years are depicted as badges (shown upper-right in Figure 10). On the day that

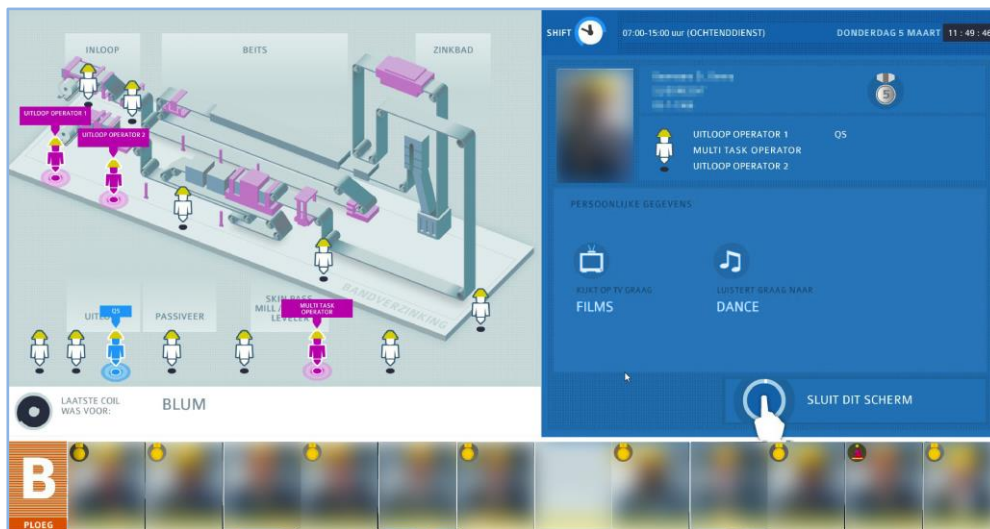


Figure 10. An example of a personal profile page that was added to the content of the screens in the galvanizing department: contribution to the team (left), personal information (right), badges added to the images of the current team (bottom).

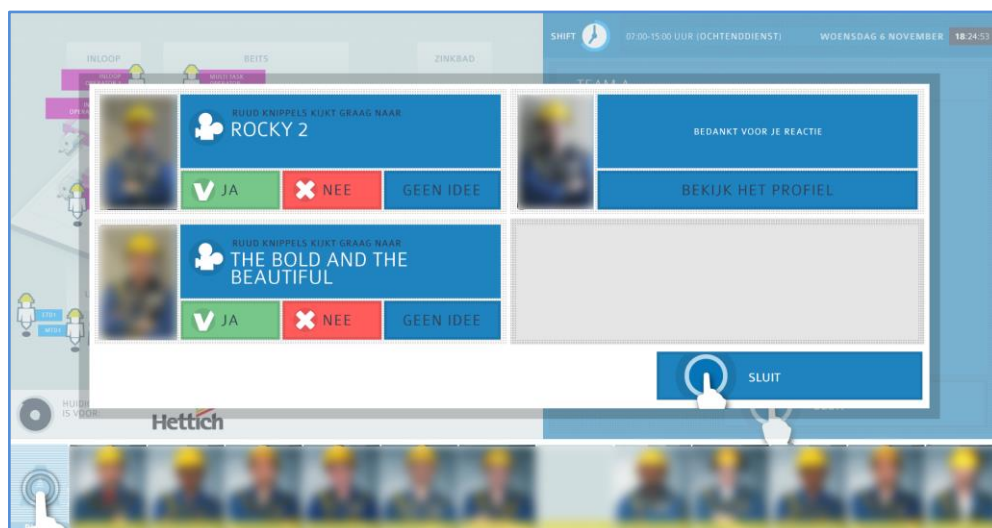


Figure 11. An example of the pop-up statements about interests and hobbies of colleagues available at the end of each shift, serving as input for the above-shown personal profiles.

an operator has an anniversary or birthday, a badge also appears on the operator's image at the bottom. The operator's ascribed roles within the team are described in text and visualized through the colored "operator figures" on the production line visual on the left.

The displayed hobbies and interests are not static pieces of information. Instead they show what colleagues have answered about the particular operator through pop-up statements. At the end of each shift, four statements about colleagues during that shift pop up, such as "Ruud likes to listen to jazz" or "Ruud likes cycling." These can be answered by pressing "yes," "no," or "don't know" (see Figure 11). The hobbies and interests data is gathered and displayed on the operator's profile page. Thus, rather than showing the correct hobbies and interests, the profile pages show what colleagues know (or think they know) about each other.

After implementation, several operators complained about the fact that their personal information (date of birth and hometown) was visible on the screen without being asked. They were allowed to opt for removal of this particular information.

METHODS

To measure the effect of (a) a new KPI screen on commitment to the team's goals and tasks and/or (b) additional personal profile pages on informal conversation and interdependence, all operators were asked to complete a questionnaire three times (see Figure 12 for the survey timeline; see the Appendix for the text of the questionnaire). The focus of the surveys was not only to measure the direct effects but also to assess how team cohesion and team performance were impacted. The questionnaires were the same for both studies in order to account for changes in the overall organization of the factory and the possible influence of one intervention on the other intervention (see Figure 13). For example, cutting operators could access the screens at the galvanizing department and vice versa. Hence, if we would find the same effects occurring in both departments at the same time this could indicate changes in the overall organization or the influence of the other intervention.

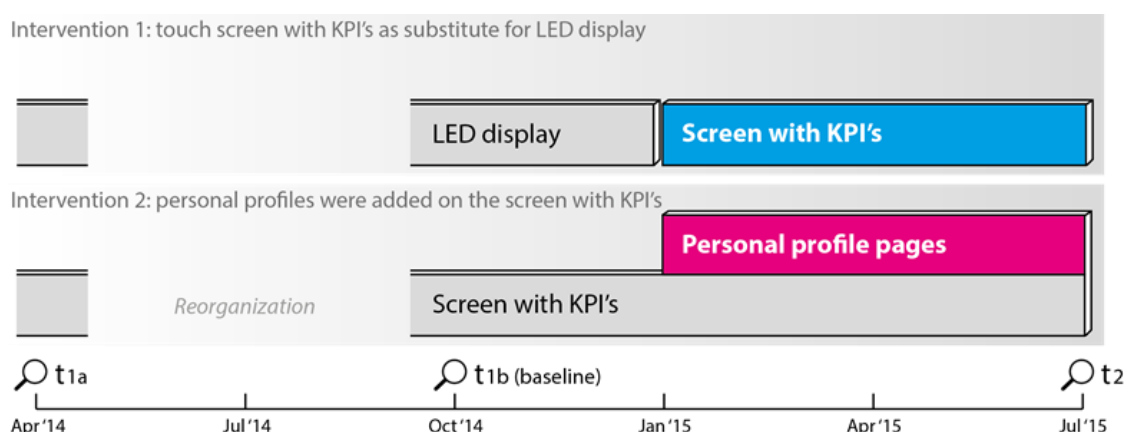


Figure 12. The scheme of the two intervention studies, with the intervention for task cohesion within cutting teams (blue) and the intervention for informal conversations and interdependence within galvanizing teams (red). The timeline for the studies and the study measurements (t) are shown along the bottom of the image.

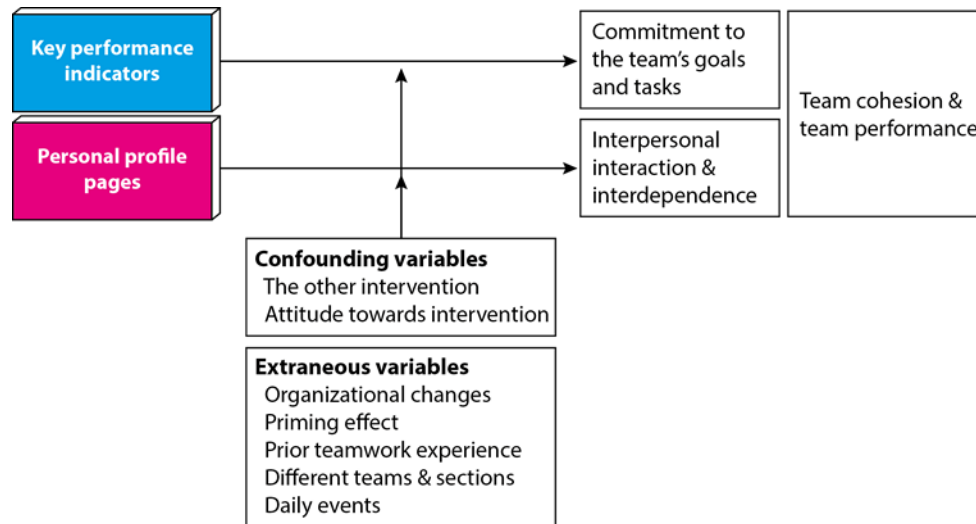


Figure 13. The interventions (boxes on the left) are assumed to directly enhance commitment and interpersonal interaction and perceived interdependence (direct arrows), thereby indirectly enhancing the operator's experiences of team cohesion and team performance, influenced by confounding and extraneous variables.

The first informant inquiry (t_{1a}) was implemented to check if the questionnaires themselves would affect the operators' teamwork experiences because the very experience of answering questions about teamwork could prime workers' awareness regarding teamwork (Murphy & Davidshofer, 2013). The data from t_{1a} also could signify the current state of the operators' teamwork experiences and indicate whether there were large differences between teams and sections, which could affect the influence of the screens on the operators' teamwork experience. To allow for the comparison of experiences of operators in different sections, the t_{1a} questionnaire inquired into the previous workday because, over a longer period, operators could be stationed at several sections. Moreover, the data could expose unanticipated extraneous variables. As shown in Figure 12, the first questionnaire-round (t_{1a}) was held in April 2014.

The second measurement period (t_{1b}) served as the study baseline measure. Unfortunately, a reorganization of the galvanizing department caused a delay in executing the baseline measurement for both studies, which eventually took place in October 2014. The questions were the same as in t_{1a} . However, instead of reflecting on the previous workday, the operators were asked to recall their experiences of the past weeks, to avoid any influence of particular day's events, such as a standstill.

Three months after t_{1b} (in January 2015), the new KPI screen (at the cutting department) and personal profile pages (at the galvanizing department) were installed. Six months after that (July 2015), the third questionnaire round (t_2) was executed to measure the effect of the interventions. To better interpret the data from the questionnaires, we wanted to know the operators' opinions regarding the new features. Thus, in addition to completing the questionnaires in t_2 , 11 operators were interviewed to evaluate the interventions. We interviewed shift leaders and operators from the different sections in the galvanizing department because they were familiar with KPIs (from the prestudy usage) and the new personal profiles.

Participants

All participants were male operators. The variation in work experience was high (1 week–40 years) and all participants were full-time employees. According to Sanders and Nauta (2004), similarity in gender and percentage of full-time employees within a team has a positive effect on team cohesion. Thus we expected relatively strong cohesion to be present even before the intervention, that is, in the prime (t_{1a}) and baseline measure (t_{1b}).

Measurement

Completing the questionnaire (see the Appendix) took approximately 20 minutes. The shift leaders were instructed to distribute and collect the questionnaires and make sure that every operator was able to fill it in on a moment where it would not disrupt their work. The first page contained statements about team cohesion (i.e., islands and pride), task cohesion (i.e., task and goal commitment), social cohesion (i.e., nonwork-related talk), and team performance. These were mainly individual-level statements, e.g., “The goals of the team were important to me” or “I talked about nonwork related topics with my colleagues.” We did not measure group-level team cohesion (Gully et al., 2012) because the game elements were aimed at enhancing the teamwork experience of the individual operators. Regarding team performance and informal conversations, the operators were asked to describe the performances and topics in a blank box. This allowed us to investigate whether their interests would change over the measurement times. The bulk of the questionnaire inquired about their experiences and behavioral interdependence with operators from each section. For each section they had to note to what extent they felt dependent on colleagues and to what extent colleagues depended on them. Similar questions were asked regarding helping and hindering, reflecting positive and negative behavioral interdependence (Deutsch, 2006).

The survey ended with questions about the importance of the screen, one’s attention toward it, and some general information. For the operators in the cutting department, these questions referred to the screen at the galvanizing department at the first data collection point because they did not have a screen in their own department yet. Because the operators’ shift leaders distributed the questionnaires, not much personal information on each respondent was asked. Yet to allow for within-subject comparisons, we did ask for service years at the factory and the total number of years they have worked. This information, in combination with knowing the team and section, made it possible to trace back to individuals. The questionnaire in the first round included an informed consent form that announced the two follow-up questionnaires. There was a strong drop in the response rate in the subsequent collection waves, which will be discussed in the following section.

Response Rate

Some of the questionnaires needed to be eliminated from the analysis because they were filled in with the same score at all statements, suggesting that the request to complete them was not taken seriously. The resulting numbers of responses per measurement time are presented in Tables 1 and 2, next to the number of employed operators.

Table 1. Number of Employed Operators and Respondents per Measurement Time in Study 1.

Cutting department		t _{1a} (Apr '14)		t _{1b} (Oct '14)		t ₂ (Jul '15)	
		operators	respondents	operators	respondents	operators	respondents
Total		35	31	35	23	35	24
Per team	A	7	6	7	4	7	?
	B	7	7	7	6	7	?
	C	7	7	7	4	7	?
	D	7	5	7	5	7	?
	E	7	6	7	4	7	?
	Unknown						24
Per section	Intake	5	0	5	0	5	1
	Cutting	5	5	5	2	5	1
	Cutter setup	5	8	5	3	5	1
	Packaging	15	10	15	4	15	5
	Release	5	5	5	2	5	1
	Several		0		4		4
	All		3		2		3
	Unknown				6		8

Note. Number of employed operators per section is based on work documents.

Table 2. Number of Employed Operators and Respondents per Measurement Time in Study 2.

Galvanizing department		t _{1a} (Apr '14)		t _{1b} (Oct '14)		t ₂ (Jul '15)	
		operators	respondents	operators	respondents	operators	respondents
Total		45	39	44	27	44	12
Per team	A	15	12	11	?	11	?
	B	15	15	11	?	11	?
	C	15	12	11	?	11	?
	D	-	-	11	?	11	?
	Unknown				27		12
Per section	Intake	6	16	8	8	8	1
	Chemistry	6	5	8	1	8	1
	Control room	6	6	8	5	8	3
	Release	6	5	8	3	8	1
	Shift leader	3	2	4	2	4	0
	Several		0		6		5
	Unknown		5		2		1

Note. Number of employed operators per section is based on work documents.

The response rate at the cutting department (Table 1) was relatively stable: 89% at t_{1a} , 66% at t_{1b} , and 69% at t_2 . However, among the galvanizing operators, the response rate dropped drastically with every round (see Table 2). In t_{1a} we received 39 (87%) responses, in t_{1b} 27 (61%), and in t_2 only 12 (27%). The response drop between t_{1a} and t_{1b} was probably caused by reorganization. Initially, the galvanizing department consisted of 3 teams of 15 operators; after the reorganization, the operators were shuffled and relocated into 4 teams of 11 operators. This most likely caused the reduced pride with the team and perceived performance they reported in t_{1b} as compared to t_{1a} (see Table 3), resulting in decreased willingness to fill in a questionnaire about teamwork. The drops in pride and performance did not recover in t_2 , which might partly explain the continued response dropout. Moreover, some shift leaders were replaced by interim shift leaders due to vacation, which might have reduced the commitment in completing the questionnaire as well.

Table 1 and Table 2 also show the incomplete data we received regarding teams and sections. From the cutting teams, all data were available in t_{1a} , yet at the galvanizing department, several operators had not filled in the section where they worked. In t_{1b} , the completed questionnaires from different teams at the galvanizing department got mixed up and several participants had not indicated at which section they had worked. In t_2 , the team data were not available at either department. Due to the missing data, we could not trace back individuals; hence, we could only analyze effects of the interventions using averages of the whole department.

Table 3. Means of Pride, Interdependence, and Performance in t_{1a} , t_{1b} and t_2 with Significance of Variation Over Time.

Cutting department	t_{1a}	t_{1b}	t_2	sig.
Pride with the team	4.41	4.18	4.29	n.s.
Perceived team performance	4.50	4.17*	4.61*	.021
Perceived interdependence ^{††}	2.95	3.14	3.53 [†]	n.s.
Perceived hindering ^{††}	1.54	1.92	2.19	n.s.
Perceived helping ^{††}	3.72	3.60	4.04 [†]	n.s.
Galvanizing department	t_{1a}	t_{1b}	t_2	sig.
Pride with the team	4.54	4.00	4.00	n.s.
Perceived team performance	4.54	4.13	4.18	n.s.
Perceived interdependence ^{††}	3.13	3.20	3.28 [†]	n.s.
Perceived hindering ^{††}	1.59	1.95	2.23	n.s.
Perceived helping ^{††}	3.29	3.50	3.51 [†]	n.s.

Note. * Significant difference between t_{1b} and t_2 ($p < .05$); [†] Significant difference between departments ($p < .05$);

^{††} No significant differences between sections ($p > .05$).

RESULTS

Before discussing the results of the study we analyze the possible effect of extraneous variables. After that we will describe the results of study 1 and study 2, ending with the operators' opinions regarding the screens.

Extraneous Variables

We used the t_{1a} data to estimate the effect of extraneous variables, such as the above-described reorganization that seemed to influence galvanizing operators' pride with the team and perceived performance. Most data were not normally distributed and we assumed that those who participated in t_{1b} had also participated in t_{1a} . Hence, Wilcoxon signed-rank tests were used to evaluate whether there were significant differences between t_{1a} and t_{1b} within the two departments. The results revealed no significant difference in any of the measured variables in either department.

Overall, the t_{1a} data suggest that all measured variables are already high at the factory (see Figures 14a-b, 15a-b & 16a-b and Table 3). Consequently, we could expect a ceiling effect and thus small-to-no effects of the interventions. Only the nonwork-related conversation response for the galvanizing department was moderate (see Figure 14a). Mann-Whitney tests were used to compare the questionnaire answers of the two departments in t_{1a} . As expected, the results indicated that galvanizing operators in t_{1a} had less nonwork-related conversation ($Mdn = 3$; see Figure 14a) than cutting operators ($Mdn = 4$; see Figure 14b), $U = 372.0$, $p = .019$, $r = .39$. Thus, we mainly expected to find an effect in nonwork-related conversation at the galvanizing department.

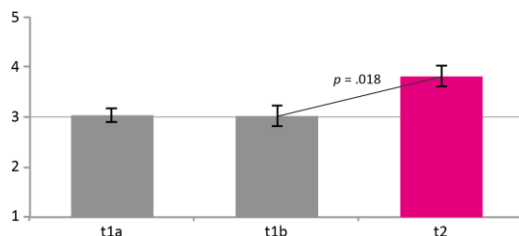


Figure 14a. (Study 2) Average self-reported nonwork-related conversations among galvanizing operators increased significantly after implementing gamified personal profile information.

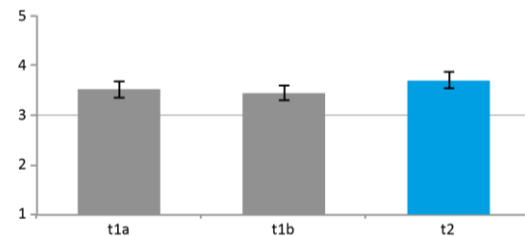


Figure 14b. (Study 1) Average self-reported nonwork-related conversations between cutting operators increased slightly over the course of the study.

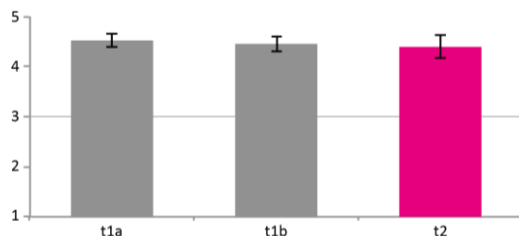


Figure 15a. (Study 2) Average self-reported commitment to team goals among galvanizing department operators.

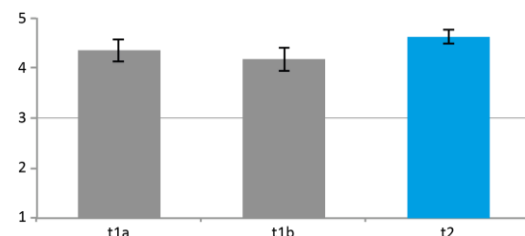


Figure 15b. (Study 1) Average self-reported commitment to team goals among cutting department operators.

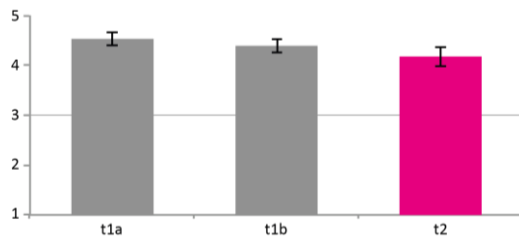


Figure 16a. (Study 2) Average self-reported commitment to team tasks dropped over the course of the study among galvanizing operators.

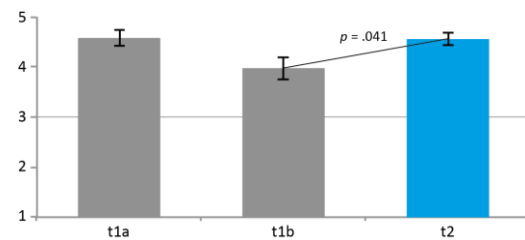


Figure 16b. (Study 1) Average self-reported commitment to team tasks among cutting operators increased significantly after implementing a screen with gamified KPI information.

Kruskal-Wallis tests were computed to evaluate whether operators from different teams and sections had different teamwork experiences in t_{1a} (and t_{1b} at the cutting department). In the cutting department, teams differed significantly in their commitment to team goals in t_{1b} , $\chi^2(4, N = 22) = 9.31, p = .037$. Post-hoc analysis using Mann-Whitney tests comparing goal commitment per team revealed that operators at one team reported significantly lower commitment to team goals ($Mdn = 3$) than operators from the other teams ($Mdn = 4$). In the galvanizing department at t_{1a} , teams differed in pride with the team, $\chi^2(2, N = 35) = 9.24, p = .007$, and perceived team performance, $\chi^2(2, N = 35) = 7.01, p = .024$. Posthoc analysis revealed that one team scored significantly lower on both variables ($Mdn = 4$) than the other two teams ($Mdn = 5$). In both departments, there were no significant differences between sections. Thus, in conclusion, teams were expected to be an extraneous factor for measuring commitment to goals in the cutting department and for measuring pride and performance in the galvanizing department.

Study 1: KPI Screen for Task Cohesion in the Cutting Department

Figures 14b, 15b & 16b and Table 3 depict the data gathered by the questionnaires in the cutting department. To examine the effect of the KPI screen on task cohesion in the cutting department, commitment to team goals (Figure 15b) and team tasks (Figure 16b) in t_{1b} were compared with the commitment in t_2 . Because the data at t_{1b} and t_2 were not normally distributed, we used Wilcoxon signed-rank tests to evaluate whether task cohesion differed between t_{1b} and t_2 . The results indicated that commitment to team tasks was significantly greater at t_2 ($Mdn = 5$) than in t_{1b} ($Mdn = 4$), $Z = -2.043, p = .041$. Figure 14a also suggests more commitment to goals at t_2 , although no significant effect was found, $Z = -1.852, p = .064$.

All other variables were examined through Wilcoxon signed-rank tests as well because they also were not normally distributed. The results indicated that the median t_{1b} scores ($Mdn = 4$) of team performance were statistically significantly lower than the median t_2 scores ($Mdn = 5$), $Z = -2.308, p = .021$. As shown in Table 3, nonwork-related conversation, pride, interdependence, hindering, and helping revealed no significant effects. Thus, the KPI screen seems to have increased the cutting teams' commitment to tasks and perceived team performance.

Study 2: Personal Profiles for Informal Conversations and Interdependence

To examine the effect of the additional personal profile pages, nonwork-related conversation (Figure 14a) and experienced- and behavioral interdependence (i.e., hindering and helping)

(Table 3) in the galvanizing department at t_{1b} were compared with nonwork conversation and interdependence at t_2 . The data on nonwork conversation in t_{1b} and t_2 were not normally distributed, thus nonparametric Wilcoxon signed-rank tests were used to compare the scores of t_{1b} and t_2 . The results indicated that nonwork-related conversation was significantly greater at t_2 ($Mdn = 4$) than at t_{1b} ($Mdn = 3$), $Z = -2.356$, $p = .018$. Regarding experienced- and behavioral interdependence independent samples, t tests were computed, as the data were normally distributed; yet no significant differences were found. Thus, from all measured variables, the additional personal profiles seem to have only increased nonwork-related conversation in the galvanizing department.

Opinions about the Interventions

The analysis of the questionnaire data regarding the operators' attitudes towards the screens indicated that galvanizing operators found the screen significantly more important at t_{1a} ($Mdn = 4$) than at t_2 ($Mdn = 3$), $U = 121.5$, $p = .049$, $r = .29$. Moreover, at t_2 the importance of the screen was rated significantly lower by galvanizing operators ($Mdn_{galv} = 3$) than by cutting operators ($Mdn_{cut} = 4.5$) $U = 61.0$, $p = .017$, $r = .42$. Among the galvanizing operators, the screens gradually became less important over time ($M_{t1a} = 3.64$, $M_{t1b} = 3.08$, $M_{t2} = 2.73$), whereas their attention toward it remained stable ($Mdn = 3$; once a week). Among cutting operators, importance and attention to the KPI information on their screen ($Mdn = 3$; once a week) remained the same at all measurement times.

After surveying the operators in t_2 , 11 galvanizing operators from different sections and teams were interviewed, including shift leaders, to gain a better understanding of their attitudes towards the game elements on the screens. In the interviews, shift leaders said they regularly browsed through the detail pages of KPIs; operators reported they sometimes browsed through them at lunchtime or before starting their shift but primarily glanced at the overview page. During the intervention period, 790 clicks on the details button were measured, which averages 6 clicks per day. All operators indicated that the KPI information was useful. One shift leader explained that the infographics made him discuss the calculation of some KPIs with the management.

All interviewees also indicated they were familiar with the personal profiles (43 clicks per day were measured), yet not all knew every bit of information that it contained. Interestingly, the personal information was known by nearly all of them (10 out of 11), probably due to the complaints about displaying personal information when they were introduced. The operators were generally negative about the information on their profiles because they considered it to be incorrect. Most interviewees were not aware of the fact that the information regarding hobbies and interests came from answers that colleagues gave through the pop-up statements. Just one operator mentioned that he sometimes had a look at his profile to see what his colleagues had answered about him. However, most operators had not understood the link. This may be explained by the fact that fewer than half of them had seen the pop-up statements, which is also reflected in the low rate of 4 clicks on average per day. Consequently, operators mentioned they would like to have more control over the information in their own profile, for example, to remove hobbies and interests that offended them.

The operators who had seen the pop-up statements indicated that they found it strange that the statements were about colleagues from the team that was leaving. At the end of a shift, statements popped up about the operators who had just completed a shift, whereas operators

who were starting their shift mainly took some time to look at the screen. As a consequence, operators from the arriving team often answered statements about operators from the departing team. Instead of using the statements as input for the personal profiles, operators suggested a preference for questions that challenged their knowledge about each other.

Regarding the visualization of an operator's roles within the team, interviewees were generally positive. They considered it to be useful information, even though nearly all interviewed operators stated that they already knew each other's skills and experience. One operator mentioned, *"I wonder why some of my colleagues have so many colored operator figures, even though they haven't worked here as long as I do. Why do I not get any additional operator figures [referring to roles in the process]?"* This suggests that the operator figures were correctly understood and raise awareness about one's contribution to the team. The badges were also positively received. Operators who had seen them (4 out of 11) considered birthday and anniversary information useful to know. One shift leader recommended adding functional badges, such as an emergency response badge.

In general, all work-related information on the screen received positive responses. However, most of the personal information was received with indifference or a negative reaction.

DISCUSSION

This article presented the explicit application of game elements at a strip galvanizing plant to enhance team cohesion within production teams. The effects of two game design interventions were measured in two separate studies. In Study 1, a screen was introduced that displayed real-time game-like infographics about KPIs to increase the operators' commitment to team goals and team tasks (H1). The study contained three measurement times: priming (t_{1a}), baseline (t_{1b}), and postintervention (t_2) measures at which operators completed the same questionnaire regarding their teamwork experiences. The results revealed a significant increase of commitment to team tasks and perceived performance from t_{1b} to t_2 .

At the same time in Study 2, gamified personal profile pages were added to already present KPI screens at another production department (galvanization). The profiles contained personal information (partly filled in by colleagues) and displayed one's roles in the team, information aimed at stimulating informal conversations and the feeling of interdependence among the operators. To measure an effect, the same study setup as in Study 1 was used. Results revealed that after introducing personal profiles, informal conversations increased significantly. Yet in both studies, overall team cohesion, interdependence and perceived team performance did not change significantly.

Overall, the quantitative results indicate no deterioration but possibly some improvement of the teamwork experience after implementing the game design interventions. Qualitative results with galvanizing department operators suggest that the game elements affected some operators in their perception of their work within their production team.

To what extent the interventions can account for the above-described effects remains uncertain, even though the analysis of variations between t_{1a} and t_{1b} did not reveal any significant variations that suggest other influences. The increase in informal conversations after the intervention in Study 2 (in the galvanizing department) was the most convincing result. Yet the dropout rate (73%) by the intervention measure (t_2) reduces internal validity. Responses at

t_2 do seem representative for the whole group, in that results on other variables (e.g., pride with the team and perceived team performance) resemble results from t_{1b} . This also suggests that the influence of daily events was probably negligible. When inspecting individual reports on nonwork-related conversation among galvanizing operators, we mainly found an absence of low ratings in t_2 , which might indicate selection bias. On the other hand, the number of subjects reporting a high rating increased by one. Due to incomplete data, we could only trace back four individuals across all measurement times. Hence, significant correlations between measurement times could not be computed.

The effects from the galvanizing department's reorganization was apparent in the drop in pride with the team and perceived team performance between t_{1a} and t_{1b} , suggesting that the self-reports were genuine. Due to the changed composition of the teams and fewer shifts per team to achieve their team targets, performance markers obviously decreased. This was recognized by the operators and appeared to affect their feeling of pride with the team. Although the reorganization took place only in the galvanizing department, it probably affected both departments. However, the cutting operators seemed to recover by t_2 .

As we clearly measured different effects in the two departments, the operators seem not to have been influenced by the intervention in the other department. Moreover, the attitude of the galvanizing operators toward the screens seems not to have been a significant influence on the effects because operators were relatively negative towards the personal information. Nonetheless, their nonwork-related conversation increased.

In retrospect, it would have been useful to also ask for the operators' feelings regarding their contribution to the team. Initially, the corresponding game elements (operator figures on the production line graphic) were intended to increase perceived interdependence, yet it is probably the factory's system factors that mainly influence these variables. Consequently, contribution visualization did not lead to significant differences in interdependence, although the interviews suggest that we could expect an increase in perceived contribution to the team.

The fact that no significant differences were measured in team cohesion and perceived team performance may have been caused by a ceiling effect or the timeframe in which they were measured. In both studies, the operators already gave high ratings for cohesion and performance in the prime and baseline measures; hence, there was not much room for improvement. Moreover, the timeframe (6 months) and number of measurements (three) might have not been appropriate for these variables. To measure perceived performance and cohesion, more measures may be needed over a longer period of time to overcome the effect of daily events and changes in the organization.

Another way to better measure team cohesion would be to define all underlying factors by group-level statements (Gully et al., 2012; e.g., "The team was committed to its tasks" instead of "I was committed to the team's tasks"). In this way, the underlying factors could provide an indication for overall team cohesion.

CONCLUSIONS

From our study we derived several lessons. We will first describe the lessons learned focusing on designing and implementing the intervention, followed by the lessons learned regarding the research design.

Lessons Learned: Game Design Interventions for Team Cohesion

Although the significance of the results in both studies is debatable, all effects hint toward a similar conclusion. The game design interventions seem to have affected only the operators' perception regarding topics that were directly addressed in the game elements. In Study 1, infographics about the team's performance improved the operators' commitment to their tasks and perception of their performance, and in Study 2, informal information stimulated informal conversations. Hence, the game design interventions appear to be successful in raising attention for particular topics.

Consequently, we suggest that developing gamification concepts is mainly a matter of making the implicit elements in the work explicit in the form of game elements, such as making performance explicit in the form of performance feedback. This is similar to what has been done in the majority of gamification studies that have been published recently (e.g., Hamari et al., 2014). Other elements, such as interdependencies within a team, could be made explicit as well. For example, one could try to make explicit the implicit conflict between the intake and control room operators, as described in the user-context analysis. Presumably, such additional interventions could raise understanding for each other's situation.

The research framework in Figure 3 proved to be a good basis for developing game elements for teamwork and suggests several opportunities in addition to the interventions that were investigated in our studies. For example, the framework suggests that to increase team cohesion, game elements should address attraction to the team. We suggested a number of solutions for that. For example, we proposed aligning individual interests with company interests by putting up banners in the production hall, displaying how the factory's clients use the coils and how this contributes to people's daily lives (e.g., relating how kilometers of guardrail saves thousands of lives each year). Another idea was to make operators clock in at the screen so they could see their image at the bottom and their operator figure appears on the production line image. Moreover, displaying the implemented pages on the operators' monitors could have increased their attention for it. However, the company's management considered these interventions to be too invasive.

In general, the operators' engagement with the elements could be improved. The interview results suggest that primarily shift leaders browse through details regarding KPIs, and operators would prefer more control over their profiles. In the current intervention, they could not directly play or interact with the introduced elements. As a result, their engagement with the elements probably was not optimal. The lack of interactivity is a problem not only in our study but in most gamification studies. Gamification is often intended just to inform users in a more stimulating manner rather than increasing the user's control over the presented elements (Hamari, 2013; Mekler et al., 2013; Mollick & Rothbard, 2013).

Moreover, moderate engagement with the screens might have been caused by the focus on team factors. As explained earlier, workers tend to focus on measures for which they are directly rewarded (Mendibil & MacBryde, 2006), which, in this case, was not the team performance. Hence, introducing game elements that directly reward team performance could improve the operators' engagement with the screens. A more drastic approach would be to relate their salary to the team's or company's performance.

This leads to our final lesson in developing game design interventions for team cohesion: organizational transparency. The game elements seemed to expose the system and strategy of the company. For example, in the cutting department, client complaints were explicitly

visualized but are presented via the KPI client satisfaction component instead of more precise alternative wording such as client complaints. However, this was the first iteration of gamifying the KPIs for the cutting department. Thus, we recommend a redesign of the page to report client satisfaction, terminology that would probably be more motivating for the operators. In the galvanizing department, such iterations have been made, resulting in the racing cars visuals. In conclusion, we propose that an important quality of gamification is to expose rather than mask existing elements of work. Therefore, we recommend transforming existing work elements into game elements, rather than adding game elements to a nongame teamwork situation, such as a point system representing a measure that initially was not yet present.

Lessons Learned: Research Design

Team cohesion was found to be a good source of inspiration for the design of game elements for teamwork. Yet measuring an effect of the designed game elements in the complex context of production teams at a factory was more difficult than anticipated in application. We had to deal with a serious dropout rate over the three data collection points. Following our lessons on gamification, one way to reduce dropout could be to transform the measurement tool into a game element. This could imply making it easier and more fun to fill in a questionnaire. Additionally it could be tailored to the context, for example, through pop-up questions throughout the workday.

The fact that implicit elements were made explicit allowed for the integration of evaluative procedures within game elements. Instead of measuring the effect externally, game elements themselves could have provided data for evaluation. For the KPI information, this is already inherently present. However, regarding one's contribution to the team and informal conversations, this would be possible as well. One suggestion would be that the operator figures are also used as a measure to evaluate shifts in the operators' roles over time. To measure the operators' interest in a particular topic through game data, interactivity is crucial. The amount of interaction could say something about the attention for a topic, as the measured number of clicks in the present study demonstrates.

Future Work

The research framework (Figure 3) suggests several options for future work. Game elements for measuring attraction to the team could be investigated, as well as game elements that explicitly address team cohesion or team processes. We posit that by implementing more such interventions in a teamwork context, significant effects could trickle down to the team's performance.

Given the current status of research on gamification, an interesting follow-up question would be can individual game-like incentive mechanisms increase engagement with teamwork processes? Most gamification experiments are based on individual incentives for individual activities (Hamari et al., 2014). However, at most companies the work is done by teams. Thus investigating game elements explicitly for teamwork is needed. When following the gamification approach of making implicit elements explicit, this would require an analysis of the dynamics in the teamwork context. If we researchers and designers want to improve collaboration within teams, we need to select specific factors within the collaborative process and address them directly through game elements. For example, complimenting each other could be made explicit by giving each other points. Over time and with a diversity of design

research, the field will gradually uncover clear design and game elements that prove to be effective in achieving team cohesion.

Final Word

The operators of the galvanizing plant seemed more autonomous than the workers in the 1950s (see Roy, 1959), yet they are still supervised by a shift leader. Moreover, the automated production line challenges the operators' autonomy in their work. When all implicit elements in the operators' jobs become explicit, they could gain more control over their activities and become more accountable for their performances, either as individuals or as members of a team. Eventually this could lead to factories where operators fully run it by themselves. But first, the operators should get the feeling of operating a huge factory and producing tons of steel with a small operating team. The game elements that are presented in this paper may be a small step towards this ideal experience.

IMPLICATIONS FOR THEORY AND APPLICATION

Currently, the field of gamification primarily focuses on individual motivation. This article provides a framework for the design of game elements for collective motivation, which could pave the road for future research and applications of teamwork gamification. Our study suggests that we need further investigation of the impact of organizational processes for both team members and the team as a whole. We suggest that team cohesion and interdependence are fundamental dimensions of teamwork that are well suited for gamification and thus important factors for investigating the gamification of organizational processes.

In two intervention studies, we showed how the theory of team cohesion could be translated into actual game elements on a factory work floor. The results confirm earlier studies, demonstrating moderate positive effects of gamification. Yet, as it is a young research field, drawing lessons from these applied cases is most important. Our main finding is that gamification successfully drew attention to elements that are explicitly presented. Yet, as gamification designers, we have to become more sensitive to the impact of increased transparency as a result of gamifying particular aspects of individual workers and allow more control by the workers over the content.

Future research of gamified interventions should address the effect of specific design decisions on the behaviors and experiences of workers in teams. Our studies suggest that long-term exposure, individual acceptance, and adaptation to the context and users are crucial in studying the effect of gamification of teamwork.

REFERENCES

- Beal, D. J., Burke, M. J., McLendon, C. L., & Cohen, R. R. (2003). Cohesion and performance in groups: A meta-analytic clarification of construct relations. *Journal of Applied Psychology*, 88(6), 989–1004.
- Berendsen, A. M. (2014). *Analysis & design for self-managing teams in organizations using a gamification approach*. Retrieved January 6, 2016, from <https://repository.tudelft.nl/islandora/object/uuid:010ab703-0d79-4f8b-91af-da61392046ad/datastream/OBJ1/download>

- Bogost, I. (2014). Why gamification is bullshit. In S. P. Walz & S. Deterding (Eds.), *The gameful world: Approaches, issues, applications* (pp. 65–80). Cambridge, MA, USA: MIT Press.
- Brounstein, M. (2002). *Managing teams for dummies*. New York, NY, USA: Wiley Publishing, Inc.
- Burawoy, M. (1979). *Manufacturing consent: Changes in the labor process under monopoly capitalism*. Chicago, IL, USA: University of Chicago Press.
- Carless, S. A., & De Paola, C. (2000). The measurement of cohesion in work teams. *Small Group Research*, 31(1), 71–88.
- Castka, P., Bamber, C. J., Sharp, J. M., & Belohoubek, P. (2001). Factors affecting successful implementation of high performance teams. *Team Performance Management*, 7(7/8), 123–134.
- Chang, A., & Bordia, P. (2001). A multidimensional approach to the group cohesion–group performance relationship. *Small Group Research*, 32(4), 379–405.
- DeShon, R. P., Kozlowski, S. W., Schmidt, A. M., Milner, K. R., & Wiechmann, D. (2004). A multiple-goal, multilevel model of feedback effects on the regulation of individual and team performance. *Journal of Applied Psychology*, 89(6), 1035–1056.
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning future media environments* (pp. 9–15). Tampere, Finland: ACM.
- Deutsch, M. (2006). Cooperation and competition. In M. Deutsch, P. T. Coleman, & E. C. Marcus (Eds.), *The handbook of conflict resolution: Theory and practice* (pp. 23–42). San Francisco, CA, USA: Jossey-Bass.
- Edery, D., & Mollick, E. (2009). *Changing the game: How video games are transforming the future of business*. New York, NY, USA: Financial Times Press.
- Frenkel, S. J., & Sanders, K. (2007). Explaining variations in co-worker assistance in organizations. *Organization Studies*, 28(6), 797–823.
- Green, M. C., Brock, T. C., & Kaufman, G. F. (2004). Understanding media enjoyment: The role of transportation into narrative worlds. *Communication Theory*, 14(4), 311–327.
- Grossman, R. (2014). *How do teams become cohesive? A meta-analysis of cohesion's antecedents*. (Unpublished doctoral dissertation). University of Central Florida Orlando, USA.
- Gully, S. M., Devine, D. J., & Whitney, D. J. (2012). A meta-analysis of cohesion and performance: Effects of level analysis and task interdependence. *Small Group Research*, 43(6), 702–725.
- Hackman, J. R., & Oldham, G. R. (1980). *Work redesign*. Reading, MI, USA: Addison-Wesley.
- Hamari, J. (2013). Transforming homo economicus into homo ludens: A field experiment on gamification in a utilitarian peer-to-peer trading service. *Electronic Commerce Research and Applications*, 12(4), 236–245.
- Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work? A literature review of empirical studies on gamification. In *Proceedings of the 47th Hawaii International Conference on System Sciences* (pp. 3025–3034). Piscataway, NJ, USA: IEEE.
- Hsieh, T. (2010). *Delivering happiness*. New York, NY, USA: Business Plus.
- Huotari, K., & Hamari, J. (2012, October). Defining gamification: A service marketing perspective. In *Proceeding of the 16th International Academic MindTrek Conference* (pp. 17–22). Tampere, Finland: ACM.
- Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annual Review of Psychology*, 56, 517–543.
- Kidwell, R. E., Mossholder, K. W., & Bennett, N. (1997). Cohesiveness and organizational citizenship behavior: A multilevel analysis using work groups and individuals. *Journal of Management*, 23(6), 775–793.
- Kozlowski, S. W., & Bell, B. S. (2013). Work groups and teams in organizations: Review update. In N. Schmitt & S. Highhouse (Eds.), *Handbook of psychology: Vol. 12. Industrial and organizational psychology* (2nd ed.; pp. 412–469). Hoboken, NJ, USA: Wiley.

- Kozlowski, S. W., Grand, J. A., Baard, S. K., & Pearce, M. (2015). Teams, teamwork, and team effectiveness: Implications for human systems integration. In D. Boehm-Davis, F. Durso, & J. Lee (Eds.), *The handbook of human systems integration* (pp. 555–571). Washington, DC, USA: American Psychological Association.
- Kozlowski, S. W., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest*, 7(3), 77–124.
- MacBryde, J., & Mendibil, K. (2003). Designing performance measurement systems for teams: Theory and practice. *Management Decision*, 41(8), 722–733.
- McGonigal, J. (2011). *Reality is broken*. London, UK: Jonathan Cape.
- McGrath, J. E. (1997). Small group research, that once and future field: An interpretation of the past with an eye to the future. *Group Dynamics: Theory, Research, and Practice*, 1(1), 7–27.
- Mekler, E. D., Brühlmann, F., Opwis, K., & Tuch, A. N. (2013). Disassembling gamification: The effects of points and meaning on user motivation and performance. In *CHI '13 Extended Abstracts on Human Factors in Computing Systems* (pp. 1137–1142). Paris, France: ACM.
- Mello, A. L., & Delise, L. A. (2015). Cognitive diversity to team outcomes: The roles of cohesion and conflict management. *Small Group Research*, 46(2), 204–226.
- Mendibil, K., & MacBryde, J. (2006). Factors that affect the design and implementation of team-based performance measurement systems. *International Journal of Productivity and Performance Management*, 55(2), 118–142.
- Mollick, E. R., & Rothbard, N. (2013, June). *Mandatory fun: Gamification and the impact of games at work* (The Wharton School Research Paper Series. SSRN, 10). Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2277103
- Mollick, E., & Werbach, K. (2014). Gamification and the enterprise. In S. P. Walz & S. Deterding (Eds.), *The gameful world: Approaches, issues, applications* (pp. 439–458). Cambridge, MA, USA: MIT Press.
- Murphy, K. R., & Davidshofer, C. O. (2013). *Psychological testing: Principles and applications* (6th ed.). Harlow, England: Pearson Education Limited.
- Reeves, B., & Read, J. L. (2009). *Total engagement: Using games and virtual worlds to change the way people work and businesses compete* (Vol. 274). Cambridge, MA, USA: Harvard Business Press.
- Reiners, T., & Wood, L. (2015). *Gamification in education and business*. London, England: Springer.
- Rovio, E., Eskola, J., Kozub, S. A., Duda, J. L., & Lintunen, T. (2009). Can high group cohesion be harmful? A case study of a junior ice-hockey team. *Small Group Research*, 40(4), 421–435.
- Roy, D. F. (1959). “Banana time”: Job satisfaction and informal interaction. *Human Organization*, 18, 158–168.
- Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, 25, 54–67.
- Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion*, 30(4), 344–360.
- Salen, K., & Zimmerman, E. (2005). *The game design reader: A rules of play anthology*. Cambridge, MA, USA: Massachusetts Institute of Technology.
- Sanders, K., & Nauta, A. (2004). Social cohesiveness and absenteeism: The relationship between characteristics of employees and short-term absenteeism within an organization. *Small Group Research*, 35(6), 724–741.
- Spataro, S. E., Pettit, N. C., Sauer, S. J., & Lount, R. B., Jr. (2014). Interactions among same-status peers: Effects of behavioral style and status level. *Small Group Research*, 45(3), 314–336.
- Suits, B. (1978). *The grasshopper: Games, life, and utopia*. Toronto, Canada: University of Toronto Press.
- Visch, V., Vegt, N. J., Anderiesen, H., & van der Kooij, K. (2013). Persuasive game design: A model and its definitions. In *CHI 2013: Workshop Designing Gamification: Creating Gameful and Playful Experiences*. Paris, France: ACM. Retrieved from http://gamification-research.org/wp-content/uploads/2013/03/Visch_etal.pdf

- Voulgari, I., & Komis, V. (2015). Exploring group cohesion in massively multiplayer online games. *Age*, 18(7), 18–24.
- Warmelink, H., Mayer, I., Weber, J., Heijligers, B., Haggis, M., Peters, E., & Louwerse, M. (2017). AMELIO: Evaluating the team-building potential of a mixed reality escape room game. In *Extended Abstracts Publication of the Annual Symposium on Computer-Human Interaction in Play* (pp. 111–123). Amsterdam, Netherlands: ACM.
- Zigon, J. (1997). Team performance measurement: A process for creating team performance standards. *Compensation & Benefits Review*, 29(1), 38–47.

Authors' Note

We thank all operators of Wuppermann Steel Netherlands for their cooperation in this study. Also, we thank the Wuppermann management, especially Guiseppe Pavone and Ruud Knippels, for openly discussing their organization and allowing unrestricted publication of results. Furthermore, we thank &RANJ for the development of the gamified interventions. This research was funded by the Dutch Ministry of Education, Culture, and Science as part of the Creative Industry Scientific Program (CRISP).

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Human Technology
ISSN 1795-6889
www.humantechnology.jyu.fi

Appendix

Questionnaire (Translated from Dutch by the authors)

This questionnaire was distributed to all operators of the strip galvanizing plant three times. The sections used in this Appendix were for the galvanizing department. Operators from the cutting department received the same questions adapted for their sections. In the first questionnaire “in the past weeks” was replaced by “yesterday.”

Could you indicate to what extent you agree or disagree with the statements below regarding **your work within the team** in the past weeks.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
In the past weeks, I felt as if the team was divided into separate islands .	☐	☐	☐	☐	☐
In the past weeks, reaching the goals of the team was important to me.	☐	☐	☐	☐	☐
In the past weeks, executing all tasks of the team was important to me.	☐	☐	☐	☐	☐
In the past weeks, the team performed well .	☐	☐	☐	☐	☐
In the past weeks, I felt proud of the team.	☐	☐	☐	☐	☐

Could you describe some of the **performances of the team**?

	Never	Rarely	Once in a while	Regularly	Often
In the past weeks, I [...] talked to my colleagues about nonwork related topics .	☐	☐	☐	☐	☐

(If applicable) Could you describe some **nonwork related topics** that you talked about with your colleagues?

(encircle one of the options below)	
In the past weeks, I worked at section...	INTAKE RELEASE CHEMISTRY CONTROL ROOM

Could you indicate to what extent you agree or disagree with the statements below regarding the **collaboration with your colleagues** in the sections in which you worked during the past weeks. The statements are the same for each section.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
INTAKE					
The activities of my colleagues at the intake section were hindering my work in the past weeks.	☐	☐	☐	☐	☐
My activities were hindering the work of my colleagues at the intake section in the past weeks.	☐	☐	☐	☐	☐
My colleagues at the intake section have done something in favor of my work in the past weeks.	☐	☐	☐	☐	☐
I have done something for the work of my colleagues at the intake section in the past weeks.	☐	☐	☐	☐	☐
My activities depended on activities of my colleagues at the intake section in the past weeks.	☐	☐	☐	☐	☐
Activities of my colleagues at the intake section depended on my activities in the past weeks.	☐	☐	☐	☐	☐
RELEASE					
The activities of my colleagues at the release section were hindering my work in the past weeks.	☐	☐	☐	☐	☐
My activities were hindering the work of my colleagues at the release section in the past weeks.	☐	☐	☐	☐	☐
My colleagues at the release section have done something in favor of my work in the past weeks.	☐	☐	☐	☐	☐
I have done something for the work of my colleagues at the release section in the past weeks.	☐	☐	☐	☐	☐
My activities depended on activities of my colleagues at the release section in the past weeks.	☐	☐	☐	☐	☐
Activities of my colleagues at the release section depended on my activities in the past weeks.	☐	☐	☐	☐	☐
CHEMISTRY					
The activities of my colleagues at the chemistry section were hindering my work in the past weeks.	☐	☐	☐	☐	☐
My activities were hindering the work of my colleagues at the chemistry section in the past weeks.	☐	☐	☐	☐	☐
My colleagues at the chemistry section have done something in favor of my work in the past weeks.	☐	☐	☐	☐	☐
I have done something for the work of my colleagues at the chemistry section in the past weeks.	☐	☐	☐	☐	☐
My activities depended on activities of my colleagues at the chemistry section in the past weeks.	☐	☐	☐	☐	☐
Activities of my colleagues at the chemistry section depended on my activities in the past weeks.	☐	☐	☐	☐	☐

CONTROL ROOM

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The activities of my colleagues at the control room were hindering my work in the past weeks.	☐	☐	☐	☐	☐
My activities were hindering the work of my colleagues at the control room in the past weeks.	☐	☐	☐	☐	☐
My colleagues at the control room have done something in favor of my work in the past weeks.	☐	☐	☐	☐	☐
I have done something for the work of my colleagues at the control room in the past weeks.	☐	☐	☐	☐	☐
My activities depended on activities of my colleagues at the control room in the past weeks.	☐	☐	☐	☐	☐
Activities of my colleagues at the control room depended on my activities in the past weeks.	☐	☐	☐	☐	☐

Below, several statements are presented regarding the **touch screen** and your work in general.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I find it important to have a touch screen.	☐	☐	☐	☐	☐

	Never	Once a month	Once a week	Once a day	Nearly every hour
I look [...] at the touch screen.	☐	☐	☐	☐	☐

I have years employed at WSN.

I have years employed in general.

End of the questionnaire. Thank you very much for your cooperation.

FACTORY WORKERS' ORDINARY USER EXPERIENCES: AN OVERLOOKED PERSPECTIVE

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Abstract: *Experiences with technology often are described as exciting and outstanding, for instance, in relation to novel technologies at home or at work. In this article, we aim to complement this perspective by emphasizing people's mundane and ordinary experiences with technology, that is, unremarkable experiences happening in the background of people's attention. Based on our investigations of user experience in a semiconductor factory, we show how such ordinary experiences are substantial in workers' everyday interactions with technology, which are mainly shaped by repetitive activities and routines. However, current conceptions of user experience seem to overlook those mundane experiences and how they can contribute to positive experiences with technology, as well as work engagement in the factory. In this article, we describe how ordinary experiences can be understood and described to amend current user experience conceptions by discussing theoretical, methodological, and design consequences.*

Keywords: *user experience theory, nuances of ordinariness, experiences with technology, computer-supported practices, factory, automated systems.*

INTRODUCTION

Positive or good user experiences are not only those that are exceptional, remarkable, or unique. A good or desired experience with technology can also stem from human–computer interactions that are unremarkable (Tolmie, Pycck, Diggins, MacLean, & Karsenty, 2002), mundane (Michael, 2003), implicit (Ju & Leifer, 2008), or on the periphery of people’s attention (Bakker, Hoven, & Eggen, 2015). This may be the case in factories, where interactions with technologies are shaped by routines and repeated activities. In order to contribute to a fuller concept of work engagement—understood as the positive fulfillment of workers’ well-being (Schaufeli, Salanova, González-Romá, & Bakker, 2002)—it is essential to holistically understand user experience in the factory. Such awareness must take into account both the exceptional experiences and the ordinary experiences with technology. Although ordinary interactions with technology are acknowledged in human–computer interaction (HCI), for example, by Dourish (2004), Kuutti and Bannon (2014), and Norman (1988/2002), there is currently little systematic discussion in the user experience literature on how ordinary experiences are shaping people’s experiences with technology. By drawing on the use case of factory work and human–machine interactions with automated systems in a semiconductor factory, we show the relevance of ordinary experiences when encountering these systems. We aim to characterize user experiences regarding their ordinariness by reflecting on our previous research on how factory workers experience working together with automated systems (i.e., robotic systems). In order to sufficiently address the dynamics of user experience in general, and specifically for the context of factory work environments, where ordinary interactions are a considerable part in daily work, researchers and designers need to pay attention to the relation between user experience and ordinary interactions. Thus, we discuss ordinary experiences on three levels: (a) theoretical conceptions of user experience, (b) research methodology, and (c) user experience design.

Referring to the research of McCarthy and Wright (2004) and considering experiences with technology as everyday phenomena, we focus on nuances of ordinariness in the everyday experiences with technology in the factory. We want to raise awareness that experiences with technology need to be considered along a continuum ranging from ordinary to unordinary experiences, changing over time. In this article, we present a conceptual framing of user experience along this continuum ranging from experiences related to repetitive everyday activities in the background of peoples’ attention (i.e., ordinary and mundane) to experiences related to infrequent situations that intervene people’s routines (i.e., unordinary and exceptional). We propose that (a) encountering technology is experienced as more or less ordinary; (b) shifts between ordinary and unordinary experiences may occur suddenly or slowly; and (c) experiences with technology can be related to different ways of encountering by users. This view complements current conceptions of user experience and consequently opens up new opportunities for user experience research and design. The conception of ordinariness can serve as theoretical basis for empirical research on experiences with technology. For example, this may guide the setup of study designs or support the selection of an appropriate method to assess ordinary user experience.

We begin this article with a description of research on everyday life in HCI and user experience. Next, we introduce the use case of a semiconductor factory and characterize everyday work in this context. Then, we describe various nuances of experience with

technology ranging from ordinary to unordinary experiences. Finally, we discuss the conception of ordinariness of experiences in relation to existing theoretical conceptions, research methodology, and design.

BACKGROUND

As theoretical background, we draw on work that discusses everyday life phenomena in HCI as well as literature on user experience. Because we are drawing on the use case of a semiconductor factory to exemplify the conception of ordinary experiences, we subsequently provide an overview of literature on HCI in the factory and user experience specifically in factories.

Everyday Life and Ordinariness

Ethnomethodology is an established theory concerned with the study of everyday life phenomena, in particular, how “the structures of everyday activities are ordinarily and routinely produced and maintained” (Garfinkel, 1967/2015, p. 38). According to Garfinkel, one way of researching this topic is to “start with familiar scenes and ask what can be done to make trouble” (Garfinkel, 1967/2015, p. 37). This is based on the assumption that mutual comprehensibility is achieved through common practices that are taken for granted most of the time; only when problems occur do these activities lose their ordinariness and become foregrounded.

In Dourish's (2004) seminal article on context in HCI, the chapter “Being Ordinary” is dedicated to the topic of ordinariness. He discussed ordinariness as basis for an alternative model of context for computer-supported practices. Therein, ordinariness is understood as an occasioned property of action, meaning that it is managed moment by moment and achieved by those carrying out an activity together. Based on the seminal work of Sacks, Dourish discussed the ordinary character of everyday activity, that is, “the very fact that most things are ordinary and unremarkable” (Dourish, 2004, p. 24). Specific things that are worth reporting, then, emerge out of the ordinary, for instance, observing an accident on the way to work. Speech reflects whether things are remarkable and exceptional or, alternately, ordinary and mundane. Again, referring to Sacks, Dourish pointed out that activities “are not simply ordinary in their own right but rather are designated as ordinary by social actors in the course of their activities” (Dourish, 2004, p. 24). Further, he emphasized that ordinariness has to be seen in relation to particular communities and sets of activities.

Embedding people's everyday routines meaningfully in interaction design also has been discussed in the literature. Based on the assumption that information and physical actions are often perceived and performed at the periphery of people's attention, Bakker et al. (2015) discussed “peripheral interaction” as a relevant direction for interaction design. With regard to the increasing ubiquity of technology, they emphasized the role of peripheral interaction designs to embed people's everyday routines meaningfully. In a similar manner, Tolmie et al. (2002) proposed the terminology “unremarkable computing,” emphasizing the invisibility of ubiquitous computing technology. Going beyond explicit interactions, Odom and Wakkary (2015) raised the notion of “intersecting” to describe relations between humans and unaware objects. Whereas explicit interactions are characterized by direct manipulation, intersecting “can range from experiences of being mindful of the artifact, to subtle uses of the artifact that

may be only briefly noticed (or go unnoticed)” (Odom & Wakkary, 2015, p. 35). Ju and Leifer (2008) explored the design of “implicit interactions,” exemplified by an automatic door opener, to make interactive technology more usable. Similar to these notions, Dourish pointed out that practiced skill is not only necessary to notice or attend to some phenomenon but also to disregard it, that is, “to render it ordinary, invisible, or unremarkable in the course of its use” (Dourish, 2004, p. 29).

Norman (1998) addressed ordinariness by discussing affordances of everyday things, for example, an everyday interaction with a keyboard or a door handle. When designing for such everyday interactions, the aim is not to design for outstanding experiences, but rather for interactions that can be performed thoughtlessly (Norman, 1998). Graham and Rouncefield (2007) discussed the notion of mundane technology in a position paper, arguing that, for instance, the use of photos within families can be studied regarding its mundaneness. Although some research in HCI focuses on everyday ordinary phenomena, the link between ordinary interactions and user experience, that is, how ordinary interactions shape people’s experiences, has not been thoroughly established yet. Thus, theoretical conceptions of user experience need to address the relation between user experience and ordinary interactions. However, current conceptions rarely do so, which we illustrate in the following section.

User Experience

User experience is an umbrella term for all forms of experiences that arise in HCI (Roto, Law, Vermeeren, & Hoonhout, 2011). Both research and design practices are engaged with people’s experiences: the former in the form of researching individuals’ experiences and how technologies influence them, the latter by designing for those experiences or creating or shaping them. Terms such as experience-centered design (Wright & McCarthy, 2010) and experience design (Hassenzahl, 2010) have found their way into the literature to emphasize the focus on experiences with technology. However, the ordinariness of experiences with technology is not explicitly reflected in these existing theoretical conceptions of user experience. Thus, the potential relevance of this type of experience has been overlooked.

The current focal point of HCI research, considered the “third wave HCI”¹ by Bødker (2015), primarily addresses home, everyday life, and culture, leading to increased attention on enjoyment, fun, and similar distinctive experiences and situations (i.e., mainly extraordinary experiences). For instance, research on the hype of consumer products indicates that iPhones, as an example, were not adopted primarily for their functional value but rather due to their social, epistemic, and emotional value, thus being a hedonic end in itself (Hedman & Gimpel, 2010). With the focus on home and leisure, entertainment also became an appealing topic for design and research. Aspects of experiences, such as enjoyment, are central, and in turn, require active experience (i.e., a cognitively and emotionally enhanced body; Nakatsu, Rauterberg, & Vorderer, 2005). This active experience is again related to a user’s level of attention, as it requires cognitive and emotional commitment from users in the interaction with an artifact, leading to a high manifestation of unordinariness.

Joy of use is another buzz term (Blythe, Overbeeke, Monk, & Wright, 2004) that puts a focus on the unordinariness of experience. For example, Carroll (2004) argued that interactions with objects are fun when they attract, capture, and hold users’ attention by provoking new or unusual perceptions or arouse emotions in untypical contexts. Remarkable and memorable

experiences, which are outstanding from everyday routines and interactions (Dewey, 1934/2005), are considered as meaningful and emotion-rich experiences with technology (Hassenzahl, 2010; Wright, McCarthy, & Meekison, 2004). Related to that is the aim to design for surprise or challenge (Csikszentmihalyi, 1990), fun, excitement, appeal, novelty, and change (Logan, 1994), as well as for surprise, diversion, or mystery (Gaver & Martin, 2000). Further, unordinary experiences are often referred to as positive experiences, such as “wow” experiences (Desmet, Porcelijn, & van Dijk, 2007), compelling experiences (Hassenzahl, Diefenbach, & Göritz, 2010; Hull, Reid, & Kidd, 2002), or engaging and absorbing experiences (Wright et al., 2004). The overall distribution of research is clearly skewed towards the exceptional, a phenomenon that can be found in theoretical framings as well.

Theoretical approaches and frameworks have evolved in the past decade that aim to describe, explain, or model what can or should be understood as user experience and what influences it (e.g., Hassenzahl, 2010; Wright & McCarthy, 2010). One of the first frameworks of experience for interaction design was developed by Forlizzi and Ford (2000). The authors built upon the work of philosopher John Dewey regarding aesthetic experience (Dewey, 1934/2005). Central to Dewey's understanding of experience is the distinction between “experience” and “having an experience” (Dewey, 1934/2005, p. 36). This distinction is relevant to understanding user experience in the field of HCI because prevalent approaches, such as the one from McCarthy and Wright (2004), are building upon Dewey. Experience in Dewey's sense is considered as a constant stream of what happens beyond specific situations, that is, the continuous perception of the interaction with one's environment: “Experience occurs continuously, because the interaction of live creatures and environing conditions is involved in the very process of living” (Dewey, 1934/2005, p. 36).

In contrast, having an experience refers to a concrete, specific situation or process with a beginning and an end. Dewey (1934/2005) referred to having an experience as being demarcated from the constant stream of experience as it is outstanding and complete within itself, having its own quality and self-sufficiency. The following quotation from Hassenzahl (2010, p. 1) nicely illustrated what is considered as having an experience: “Luzine [a restaurant] was an experience. It was an episode, a chunk of time that I went through and I am going to remember. It was sights and sounds, feelings and thoughts, motives and actions, all closely knitted together and stored in memory, labeled, relived and communicated to others.”

Distinguishing between an experience and experiencing is also essential for conceptions of temporal user experience. Luo (2012, p. 353) differentiated between “short-term and long-term” user experience. Short-term user experience is dynamic and connected to a specific moment or situation, whereas long-term user experience is created cumulatively over time. Whereas the former refers to a specific interaction having a beginning and an end (considered as an experience by Forlizzi & Ford, 2000), the latter represents an accumulation of single interaction episodes in the sense of recollecting multiple periods of use (Roto et al., 2011), not reducible to single interaction episodes.

Although the presented understandings and facets of user experience tracing back to Dewey (1934/2005) do not explicitly exclude ordinary experiences, they neither clarify their role nor their relation to unordinary experiences. The theoretical approaches in particular lack a distinct discussion of the mundane. In order to create more awareness for these forms of experiences and, as a result, provide a basis for reflection and further research, this article contributes to a discussion of and a theoretical frame for ordinary experiences. This provides

a basis for articulating what form of ordinariness is investigated, evaluated, or designed for. In order to ground this discussion, we develop the argument based on the example of a semiconductor factory context because everyday routines play a crucial role therein. Thus, the following subchapter presents research within this context, especially on how workers experience interactions.

User Experience in the Factory

For decades, scientists have been occupied with investigating factory work from a point of view of classical or social psychology (e.g., Brown, 1954; Fischer et al., 1998; Noor & Abdullah, 2012). Considerable research addresses health or safety aspects, as well as ergonomics. Regarding humans' interaction with systems, the factory context has been less prominent in recent HCI research and publications. Little research material can be found that makes factory workers the focal point when designing interfaces. In 1991, an IEE colloquium (i.e., HCI: Issues for the Factory) dealt with the psychological basis for computer system design, operator support systems, and industrial inspection. This colloquium, however, remained a unique event and was not repeated in any related form in subsequent years.

Only recently, a distinct human-centered orientation has evolved for factories. For example, May et al. (2015) indicated that workplaces of the future should be worker-centric to optimize production performance. That means that workplaces should fit workers' needs. Similarly, Village, Searcy, Salustri, and Neumann (2015) argued for an early consideration of human factors in production design processes to improve workers' performance and well-being. However, field studies focusing on human-computer interactions with systems specifically in the factory context have been less prominent. One reason for this may be the fact that a factory represents a very challenging research context. The first and foremost demand when doing research in this context is to not hinder daily work and production processes (Björndal, & Ralph, 2014; Tscheligi et al., 2012). Further, the complexity of the factory environment (in terms of work practices, processes, and equipment) represents a hurdle for researchers (Weiss, Kluckner, Buchner, & Tscheligi, 2012). Access is crucial and often difficult in terms of sampling (i.e., accessing people who are the focus of the research) or the physical presence of a researcher (i.e., accessing specific areas in the factory; Wurhofer, Fuchsberger, Meneweger, Moser, & Tscheligi, 2015). Thus, the restricted accessibility and complexity of the factory context may be one of the reasons why user experience research in this context is scarce (Ardito, Buono, Caivano, Costabile, & Lanzilotti, 2014; Tscheligi et al., 2012).

Fallman, Kruzeniski, and Andersson (2005) pointed out the importance of investigating new technologies in the factory context and considered the industrial use of information technology (IT) as paradigm shift. In recent years, some researchers have attempted to promote user experience research in industrial settings by pointing out the importance of user experience goals regarding the design of industrial systems (Kaasinen et al., 2015), ways to create value for companies through user experience research (Väättäjä, Seppänen, & Paananen, 2014), or how to investigate user experience in industry (Ardito et al., 2014). Although it is challenging to research an industrial context, it is valuable in order to improve workers' user experiences. For instance, user experience goals can be beneficial in guiding the design of industrial systems (Kaasinen et al., 2015). Evoking positive and meaningful experiences at work—for example, personal engagement (Lu & Roto, 2015)—has various positive effects for both employees and employers

(Lu & Roto, 2015). Positive experiences with technology are, for example, related to the worker's efficiency, work satisfaction, and professional pride. This, in turn, affects productivity, competitiveness, or brand image (Vääätäjä et al., 2014).

Even though it is arguably important to create ordinary experiences that are positive and meaningful for workers, our review of the literature demonstrates that there is a lack of orientation toward the mundane in user experience theory. In this article, we close this gap by promoting sensitivity for these kinds of experiences, addressing the following overall research question: How can users' experiences be described regarding their ordinariness? Therefore, we draw on a use case of human-machine interactions with automated systems in a semiconductor factory (Meneweger, Wurhofer, Fuchsberger, & Tscheligi, 2015), as described in the next section.

THE USE CASE OF A SEMICONDUCTOR FACTORY

To gain a deep understanding of ordinary user experiences, we examined work practices in a semiconductor factory. The respective factory is a major industry company in the electronics sector, producing microchips. We collaborated with this factory within a national research project over 7 years. The overarching research goal of this project was to understand and characterize the contextual peculiarities of user experiences emerging within the specific and challenging context of a factory. We conducted a range of interview studies, ethnographic research, contextual inquiries, surveys, and workshops (for an overview of our research, see Wurhofer, Fuchsberger et al., 2015). Over the years, we investigated workers' experiences with robotic systems, mobile interfaces, assistive systems, and collaboration tools, thus providing rich insights into ordinary factory life. By exploring different facets of human-machine interactions in this factory through an experiential lens and reflecting on related literature, we recognized an over-representation of unordinariness in current user experience concepts. This might derive from a primary focus on enjoyment, fun, and other outstanding experiences, as described above. However, that did not seem to represent the workers' day-to-day experiences with technology in the factory. The relevance of ordinary experiences with technology that we observed in the factory is not explicitly reflected in current user experience literature. However, we consider evoking ordinary experiences as an essential goal for designing and deploying technology (also beyond the factory context). Thus, user experience research can benefit from a look at factory workers' experiences, where ordinary experiences are specifically visible and technology that was once novel and exceptional has become ordinary and mundane.

Approach: Reflecting on Workers' Experiences in the Semiconductor Factory

We developed the concept of ordinariness by drawing upon our long-term engagement in the semiconductor factory. In particular, we found that experiences evoked by encountering different kinds of systems in this context can be described as more or less ordinary. This motivated us to theoretically reflect on the ordinariness of experiences with technology. We further elaborated the initial conceptual idea of ordinariness by reflecting on data gathered within an in-depth interview study about workers' experiences with automated systems (Meneweger et al., 2015; Wurhofer, Meneweger, Fuchsberger, & Tscheligi, 2015).

This previous study aimed to investigate workers' experiences regarding the deployment of industrial robots in this factory. To investigate how workers experienced the interaction with robots and changing working procedures, we conducted 10 narrative interviews with workers who experienced the deployment of robots in their working areas. The participants were recruited by a manager of the automation department, and within the selection process, diversity was sought in terms of age, working experience, and role. We interviewed eight male and two female workers, with a mean age of 40 years ($SD = 12$), ranging from 22 to 57 years. Their average working experience at the specific factory was 16 years ($SD = 11$), ranging from 0.5 to 30 years. Work experience with the robots ranged from 0.5 to 5 years. After the workers gave their informed consent, the interviews were conducted in a quiet and comfortable atmosphere (i.e., a meeting room). Each lasted about an hour and all were audio recorded and later transcribed. The interviews were conducted in German; the interviewees and the interviewer were fluent in German. We applied an open-structured interview guideline aimed at collecting workers' personal experiences in the form of stories and situation narratives. The main task of the interviewer was to stimulate personal reports by asking narrative trigger questions (e.g., "Can you remember the first day working with the robot? Please tell me about that."). In line with Flick (2000), the interviewer served primarily as a listener as the participants recounted their experiences. The focus of the interviews was on three stages of becoming familiar with the automated systems: (a) before working with the robots; (b) briefing, training, and first interactions with the systems; and (c) daily work with the robots. Thus, we collected episodes of certain experiences, ranging from pre-expectations and first-time experiences to the current experiences of workers. The specific benefit of this approach is that the open-structured interview provided the interviewees freedom to articulate their experiences, thoughts, and reflections as they prefer, meaning the participants decided what experiences they recounted. This allowed us to get rich insights into everyday factory life and corresponding experiences² (see Meneweger et al., 2015; Wurhofer, Meneweger et al., 2015).

The primary analysis of the data was conducted by the first two authors, with the final authors contributing to the process of refining and grounding the insights and reflections. Thus, to theoretically frame ordinary experiences, several reflection sessions were conducted during summer 2015. Within these sessions, the first two authors examined the use case of the semiconductor factory regarding ordinary experiences by reflecting on the interview data, that is, revisiting the data through the lens of ordinary experiences. These two also conducted the interview study and were familiar with the gathered data and as well with the specific context on site, which they had researched for several years. The reflection sessions followed an open discursive style and aimed at characterizing the interview data regarding the ordinariness of experiences. Thereby, we aimed to create links between the conceptual idea of ordinariness and the data gathered in the interview study. Based on our assumption that experiences are more or less ordinary, we structured the reported experiences regarding their concreteness. For example, we contrasted reports of distinct experiences with specific information on space and time against abstract, rather general descriptions of reoccurring situations. Further, we structured activities related to the automated systems (i.e., the way in which the workers encountered the systems) and mapped them to the degree of ordinariness. Within this iterative process, the concept of ordinariness evolved and was revised and enhanced based on feedback and discussion with the two other researchers who had experiences with the specific factory as well, but who were not directly involved in the interview study.

Everyday Work with Automated Systems in the Semiconductor Factory

To provide a better understanding of the research context and our insights, we describe the daily work and experiences of this factory identified in previous studies (e.g., Meneweger et al., 2015; Wurhofer, Meneweger et al., 2015). In this context, interactions and related experiences are shaped mainly by repetitive everyday activities. Despite that, when infrequent incidents interrupt workers' routines, shifts between ordinary and unordinary interactions occur. For example, working activities are interrupted when workers have to deal with unexpected errors or sudden problems that need to be solved immediately. Additionally, working routines are reshaped when new technologies are introduced that fundamentally alter working procedures (e.g., the introduction of new robotic systems to perform tasks completed manually earlier).

The overall goal within the production process is to have as few defects ("zero-defect production") and as high performance as possible to maximize the factory's output ("throughput"). Products (i.e., microchips produced on silicon wafers) are produced on shop floors, which often are loud and busy places. Most of the fabrication systems are permanently running to allow 24/7/365 production. The factory contains several clean rooms, that is, areas with low contamination with specific restrictions and rules to ensure a nearly dust-free environment for producing the microchips. Thus, operators have to wear special clothing (e.g., gloves, head covering, and special suits). Before an operator enters the clean room to work, he/she must put on the special clothing and pass beneath an air shaft that blows away particles. In the clean room, there is a range of fabrication machines ("equipment") needed for the various steps in producing microchips. In general, microchips are produced through building multiple layers on the silicon wafers.

Over the years, increasing automation has been deployed at the production site, for instance, for transportation and pick-and-place tasks (i.e., grasping and moving artifacts from Point A to Point B). The human operators are responsible primarily for maintaining a fluid production process and, depending on the automation level, to distribute the products or components to the designated equipment.

In regard to these automated systems, the workers perform mainly loading and unloading activities. Additionally, they monitor and/or adjust settings for specific production processes. To illustrate operators' everyday work in the semiconductor factory, we present quotes³ taken from the narrative interviews with the operators. An operator described the daily work in the factory as follows:

Overall, we are loading [wafers] onto the equipment and unloading them, monitoring processes, and correcting errors if they occur. Yes, generally speaking, that's the main work. From time to time, necessary tests of the systems are also completed by us [operators]. Wafers, which are ready for further processing, have to be delivered. Visual checks and measurements that are related to our working area, all such things are done by us. (Operator, female, 32 years)

Less frequent activities are, for example, learning to operate and interact with newly introduced machines or interfaces, as shown in a previous study (Meneweger et al., 2015). Knowledge acquisition is especially relevant for learning to manage the robot when system errors occur. In the long run, operators develop routines in handling the robots due to continuously interacting with them. In the short run, however, learning how to operate the

robots is—in addition to brief trainings—often characterized by trial and error strategies, as one operator described: “*When an error occurred, someone came and you watched him [fix the error]. Then, he told you that it works like this and that or that you just have to confirm and suddenly you adopted that*” (Operator, male, 39 years).

Due to the demand that the systems run continuously, addressing errors (in the product or production process) is an essential activity for the workers. Moreover, troubleshooting is disruptive and often specific:

It is assumed that they [the robots] work autonomously, but, as already stated, sometimes problems occur related to the robot. If there is no one [of the technicians] available—as is the case during night shift—we [operators] have to cope with this by ourselves. It is often the case that he [the robot] blocks our path to the equipment, which we could operate if the robot would not be there. Therefore, we have to be able to help ourselves every once in a while. (Operator, female, 32 years)

However, for workers mainly focusing on error handling and troubleshooting in their daily work (e.g., maintainers, service technicians), regularly occurring problems may be something ordinary. Next to error handling and troubleshooting, adaption represents another example for changing experiences (regarding their ordinariness) in the factory. As stated by an operator, workers need to adapt continually to the robots:

Previously, our tables [for storing the wafers] were distributed all over the clean room. There was enough space to move and to work. You could prepare and arrange the wafers well. Today, there are just the trays mounted on the equipment and I have to wait until one has finished processing. I have to remove it [the tray of wafers] and take it away because I cannot get there [to the machine] with the cart anymore. I have to carry it for 20 meters and then get the new one in. Previously, the cart was placed stationary in the center [of the clean room] and it was possible to put everything on the cart. At the beginning of the shift, I could deliver everything and I used the cart also for carrying them away. (Operator, male, 57 years)

This means that workers had to adjust their working routines and practices to the robot's behavior or very presence. Such a reconfiguration of existing practices represents a break in existing work processes, and thus, over time, new (adapted) routines and practices evolve.

Increasing the number of production units and productivity are important goals in these types of factory environments. When technical errors occur, troubleshooting and fast correction of errors are highest priority. Especially in such situations, good teamwork and problem-solving abilities are crucial from a worker's perspective. Beyond handling the machines, the social environment also plays a crucial role in operators' daily work. On one hand, unmotivated colleagues or unequal treatment from superiors, as well as lack of staff, can be considered as negative experiences in daily work life. On the other hand, motivation and appreciation of work done by an individual or the group, as well as self-affirmation, are causes of positive experiences (Wurhofer, Buchner, & Tscheligi, 2014). By referring to the use case of user experiences resulting from interactions with automated systems in the factory, we outline our concept of ordinary experiences in the following sections.

NUANCES OF ORDINARY EXPERIENCES IN THE FACTORY

In order to conceptualize the notion of ordinary experience, we reflected on insights from our long-term engagement in the factory regarding various aspects of ordinariness. In other words, we assessed whether our perspectives on the incidences pointed toward one of the two poles of ordinariness and/or revealed something notable about using or, as we present below, encountering technology. Thus, this section is dedicated to describing those conceptual facets of ordinariness.

Conceptualizing Ordinariness

According to Abrahams, ordinary experiences are typical in the sense of “what happens again and again to individuals finding themselves in similar situations” (Abrahams, 1986, p. 60). In our studies, we found that most everyday interactions with technologies in the factory are related to daily routines and practices without any specific value or memory of them. Only when the routine is disrupted by specific incidents do practices require increased attention or are perceived as specifically valuable. We consider experiences that someone has no specific memory of, attributes no specific value to, or requires hardly any of someone’s attention as *ordinary experiences*. Experiences that are memorable, valuable, or the focus of people’s attention are referred to as *unordinary experiences*. This represents a conceptual distinction, highlighting that experiences with technology emerge along a continuum of experiences ranging from ordinary to unordinary experiences.

Most of the time, workers are not expected to directly manipulate systems that are supposed to run automatically; therefore, the systems are mainly perceived peripherally by the workers. Encountering such automated systems can be considered as intersecting in the sense of Odom and Wakkary (2015), that is, workers being mindful of the system or just briefly noticing it. Encountering these systems corresponds to what Dewey (1934/2005) referred to as experience, that is, the constant stream of what is experienced beyond specific situations. From our point of view, this can be the most basic form of ordinary experience. However, when the systems in the factory stop running smoothly because of, for example, failures (problems, errors, malfunctions), experiences can be evoked that are “demarcated in the general stream of experience from other experiences” (Dewey, 1934/2005, 37). This is what Dewey considered as having an experience—a concrete, specific situation or process with a beginning and an end. Such experiences that require the attention of the user and which the user attributes value to can be considered unordinary experiences. Corresponding to the dynamic character of experiences, the transformations between ordinary and unordinary experiences within this conceptual distinction are conceived as especially relevant.

In our research, the term *encountering technology* refers to a wide variety of interactions with technology in the factory, ranging from explicit, direct manipulation of a system to the peripheral interaction with unremarkable systems. Related technology experience may be more or less ordinary, depending on the specific situations and the different ways of encountering technology. For exemplifying the ordinariness of experiences in the next section, we refer to the following notions of encountering automated systems. In addition to the (a) properly running automated systems, where no explicit interaction and no direct manipulation of the system is needed, we distinguish between (b) interactions with specific interfaces or systems, for instance, a single control panel of an automated system; (c) tasks in the factory where systems and interfaces

are involved and interacted with, for example, as part of maintenance procedures; and (d) routines related to technology usage, for example, being responsible for monitoring systems in a certain area of the factory. As part of the work routines in monitoring these machines, several tasks are involved and various kinds of systems and interfaces are engaged. In these ways of encountering technology, different attributes can be ascribed to indicate whether the encountering is oriented toward ordinary or unordinary. Within our conception of ordinariness, we use attributes such as repetitive, frequent, and everyday to describe ordinary ways of encountering, whereas attributes such as initial, infrequent, and intervening will be used to describe unordinary ways of encountering technology (see Figure 1).

Experiencing Automated Systems in the Factory

Employing the use case of a semiconductor factory, we describe in this subsection the experiences with automated systems regarding their ordinariness. Figure 1 presents distinct nuances of ordinary

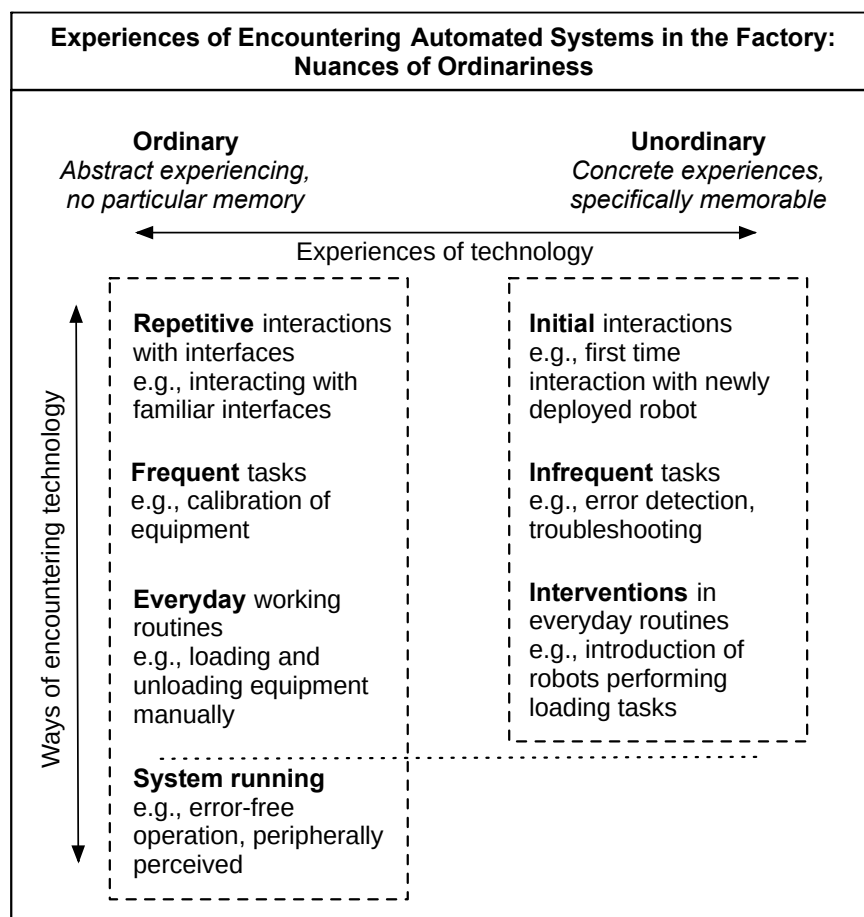


Figure 1. Examples of ordinary and unordinary experiences in a factory context from a worker's perspective, representing the nuances of ordinary experiences in relation to different ways of encountering technology. The peripheral perception of a properly running automated system, as well as repetitive interactions with interfaces, frequent tasks, or everyday working routines are typically related to ordinary experiences. In contrast, initial interactions, infrequent tasks, or interventions in everyday routines, are frequently experienced as unordinary.

experiences. We explain the figure in the following. In addition to the peripheral perception of a properly running automated system, the factory work is often characterized by repetitive interactions with interfaces. Workers are familiar with these interfaces so that interactions only require a low level of attention.

Experiences of repetitive interactions like the everyday handling of familiar interfaces may be considered as rather ordinary because they do not require much of the workers' attention and cannot be specifically remembered by workers. Frequent tasks like the calibration of equipment represent routine activities that may be experienced as ordinary. Such recurring actions of daily work life are probably not linked to memories of a specific situation or context, but rather represented as cumulative episodes of encountering technology. Further, we consider experiences of everyday working routines like manually loading and unloading the equipment in the factory as ordinary.

In contrast, experiences of initial interactions with systems, for instance, the first interaction with a newly deployed robot, are rather unordinary because of their novelty. They require higher attention as the workers are not yet used to the interaction. Infrequent tasks related to specific incidents like error detection or troubleshooting also require attention and are memorable to the workers, being linked to unordinary experiences. Such actions are unexpected and interrupt the current workflow, attracting the workers' attention. Workers are usually able to remember the concrete situation and context of the incident. Interventions in everyday routines, like the introduction of robots that substitute loading activities, interfere with everyday activities and therefore might be experienced as unordinary.

These different ways of encountering automated systems are interwoven in a complex way and cannot be considered as mutually exclusive contrastive pairs (e.g., repetitive vs. initial). Although experiences of initial interactions will interfere with experiences of repetitive interactions, initial interactions might also intervene with frequent tasks and everyday routines. Workers' experiences occur on a continuum of ordinariness according to different ways of encountering. Thus, the continuum ranges from repetitive, regular experiences of encountering technology to unique, exceptional experiences of encountering technology.

From a temporal perspective, we can depict the shifts between ordinary and unordinary experiences. Karapanos, Zimmerman, Forlizzi, and Martens (2009) already explored the different phases of user experience over time (being represented as shifts of experiences). However, they do not consider shifts between more or less ordinary experiences. Shifts from expected, unremarkable situations to unexpected, remarkable situations were also attended to in ethnomethodology (Garfinkel, 1967/2015). As humans take everyday activities and situations for granted most of the time, ethnomethodologists aim to challenge this by "making trouble" through drawing otherwise unquestioned activities to the foreground. Breaching experiments (see Garfinkel, 1967/2015) are the most frequent method of achieving this foregrounding. Although breaching experiments intentionally and artificially aim to provoke exceptional situations, such situations spontaneously occur in the factory. For example, exceptional situations evolve when new systems that radically change working procedures are deployed (e.g., robots as coworkers) or when unexpected incidents or errors interfere with everyday work. Figure 2 presents a sketch of how nuances of ordinariness evolve when encountering technology over time. It illustrates shifts in the ordinariness of experience. For instance, when a new system is deployed, routine activities are interrupted by this incident, reflected in a sharp rise towards unordinary experience. With increasing time, users become habituated to the new system, reflected in a slow shift towards ordinary experience. These

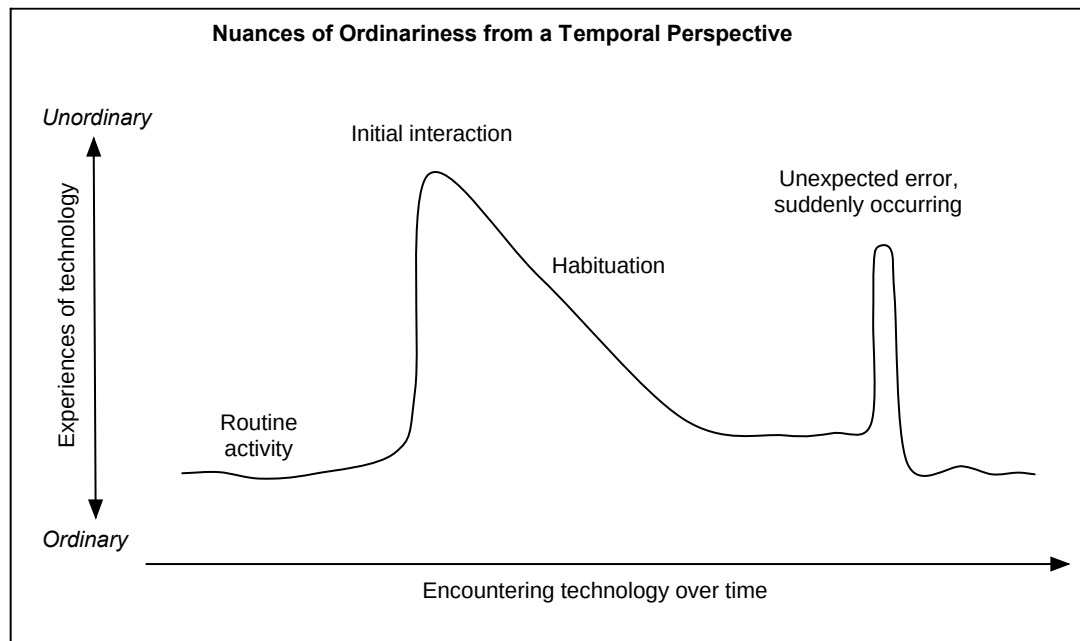


Figure 2. Visualization of how experiences in the factory can evolve over time with regard to ordinarity. By representing ordinarity (y-axis) in the course of time (x-axis), the figure illustrates shifts in the ordinarity of experiences. Ordinary, routine experiences are characterized by a rather smooth and shallow course. A sharp rise of the curve towards unordinary experiences represents exceptional, remarkable experiences (e.g., initial interaction with a newly deployed system). A slow decline of the curve reflects habituation effects (i.e., decrease towards more ordinary experience).

routine activities can be interrupted again by suddenly occurring errors or other unexpected incidents, again illustrated by a sharp rise towards unordinary experiences. Figure 2 is a simplification of everyday work life, where workers' experience is shaped by a multitude of technologies, mostly in workers' peripheral perception. However, this sketch illustrates the dynamic nature of experiences floating in between the ordinary and the unordinary.

Postulating Ordinarity of Experiences

Our reflections on ordinary experiences are specific to the semiconductor factory context, as the high importance of routines and the repeatability in results skew toward ordinary experiences rather than a balance between ordinary and unordinary ones. However, the characteristics of ordinary experiences may apply to diverse contexts, for example, other workplaces, home, or other leisure domains. The following characteristics of ordinary experiences outline our reflections on ordinary experiences.

- **Encountering technology is experienced as more or less ordinary.** Experience with technology can range from ordinary to unordinary experiences. Figure 2 illustrates this conception by representing ordinarity (y-axis) over the course of time (x-axis), that is, visualizing how experiences evolve over time in regard to ordinarity.

- **Shifts between ordinary and unordinary experiences may occur suddenly or slowly.** Transitions between ordinary and unordinary experiences happen at different paces, that is, anywhere between fast or slow (see Figure 2). For example, interactions with technology may be characterized by learning and habituation effects, corresponding to smooth transitions regarding the ordinariness of experience. In contrast, interactions that are affected by unexpected incidents or sudden interruptions may be reflected by sudden changes of ordinariness.
- **Experiences with technology can be related to different ways of encountering.** Encountering technology may reach from peripheral perception of running systems to periodic interactions with interfaces and tasks in the factory, to ongoing routines. Each of these different ways of encountering can be experienced as rather ordinary or unordinary, depending on the very specific situation in which the encountering of the technology takes place.

DISCUSSION

We clustered the following discussion along the areas that are affected by a conceptual distinction between ordinary and unordinary experiences: theoretical conceptions, research methodology, and design. By looking at this conceptual distinction from different angles, we show the specific value of our conception of ordinariness for HCI.

Theoretical Conceptions

“Normal is an illusion. What is normal for the spider is chaos for the fly.” (Charles Addams, n.d.)

This quote from cartoonist Charles Addams, creator of the Addams Family, nicely illustrates the subjective component of ordinariness. What is experienced as something outstanding and unordinary by someone could be experienced, at the same time, as something ordinary by someone else. To understand the nuances of ordinariness, it is necessary to explore people's subjective views and reflections. What people may consider as ordinary is quite context dependent and situational. According to Dourish (2004), ordinariness is actively constituted in the course of interactions and within certain communities. Thus, people may have a shared understanding of what is experienced as more or less ordinary within a specific context and community. So it is more about intersubjectivity than subjectivity (Dourish, 2001). Referring to Addams' quote above, other spiders may experience this situation also as normal, whereas other flies will experience it drastic as well. Transferred to the factory context, the same situation (e.g., occurrence of a specific error) may be ordinary for technicians but exceptional for operators. As a consequence of this argument, establishing a formula to measure the ordinariness of specific interactions would not seem possible.

Reflecting on the ordinariness of workers' experience in the factory, time is a crucial issue (see Figure 2). In the course of time, experiences often move from being new and extraordinary toward becoming accustomed and ordinary. Forlizzi and Ford (2000) stated that recurrent experiences become more and more automatic with repeating practice. In their framework, they consider this migration as a shift from cognitive experiences to subconscious ones, where learning and habituation play important roles. With increasing practice and frequency of

specific operations, activities, or actions, a decrease in the focus of attention may be required. However, this is no linear process, because ordinary experiences may be suddenly interrupted by unexpected incidents, attracting attention and generating cognitive load, suddenly becoming an unordinary experience. In temporal models of user experience, like that of Luo (2012), long-term user experience—as created cumulatively over time—highly corresponds to how we describe workers’ reflection on ordinary experiences. Similarly, what is considered a short-term user experience—being dynamic and connected to a specific moment or situation—corresponds to workers’ reflection on unordinary experiences.

The relevance of everyday routines for HCI that are highlighted by Kuutti and Bannon (2014) can be linked to the ordinariness of experiences in user experience conceptions. Kuutti and Bannon introduced a distinction between a prevalent “interaction perspective” in HCI that focuses on momentary and ahistorical human–computer interactions and an underrepresented “practice perspective.” The practice perspective focuses on processes and long-term actions, which are interwoven with the physical, social, and cultural surroundings. Practices are composed of inseparably intertwined elements such as “physical and mental activities of human bodies, the material environment, artifacts and their use, contexts, human capabilities, affinities and motivation” (Kuutti & Bannon, 2014, p. 3545). The conception of ordinary experiences, as proposed in their article, is anchored in the practice paradigm. The question of whether encountering technology is experienced as more or less ordinary also cannot be reduced to single interactions but has to be considered as emerging out of everyday “computer-supported practices” (Kuutti & Bannon, 2014, p. 3550). This stands in contrast to (or perhaps expands) traditional usability concepts. Usability, often understood as effectiveness, efficiency, and satisfaction (International Organization for Standardization [ISO 9241-11], 1998), provides an interaction perspective that is reduced to momentary, explicit interactions. From a practice perspective, this falls short, even if learning, novelty, or improvisation—as suggested by Adler and Winograd (1992)—are included within such a conception, in that temporal trajectories of physical, social, and cultural surroundings are left out.

Taking an experiential, practice-oriented perspective allows researchers to understand that the same interactions can be experienced simultaneously as ordinary or unordinary (by different people). For example, when looking at human practices, one cannot assume that bad usability necessarily leads to bad (unordinary) experiences. Neither must a system with a good usability lead to positive experiences. To understand whether an experience with technology is ordinary or unordinary, it requires us researchers to zoom out and look more broadly at human experiences and how they are embedded in practices. This is especially relevant for experiences evoked by systems where no specific or explicit interaction takes place (e.g., ambient technologies, autonomous systems, or factory automation). Considering interactions, tasks, and routines as embedded in everyday practices is helpful to better understanding how specific ways of encountering technology may be experienced as more or less ordinary. However, further research, especially one that explicitly focuses on the relation of practices and experiences, is needed to further reflect on this relationship. Following Kuutti’s (2010) claim regarding a conceptual and theoretical debate on user experience, we showed in this article that it is beneficial for research to draw attention to the ordinariness of experiences by articulating, reflecting, assessing, and designing (for) those experiences. This means that ordinariness—with its temporal, intersubjective, and situated qualities—needs to be an explicit dimension specified and acknowledged in existing user experience frameworks and theories. By doing so, directions

for future research can be articulated that facilitate the study of ordinariness of experience with technology in varying domains.

Methodological Approaches

“Speech is organised so as to designate the distinctions between those things that are remarkable and those that are not.” (Dourish, 2004, p. 24)

Dourish's (2004) statement emphasized the significance of verbal accounts to access ordinariness of experiences. User experience research provides a variety of notions that aim to frame experience with technology (e.g., Forlizzi & Ford, 2000; Hassenzahl, 2010; McCarthy & Wright, 2004). In reference to ordinariness, however, there are no explicit reflections on how to access these forms of experiences, that is, what implications the sensitivity toward the nuances of ordinariness brings in terms of appropriate methods to capture experiences.

Certain research methods are particularly suitable for capturing specific aspects of experiences with technology. Thus, researchers should reflect on how specific methods can be applied to capture various nuances of ordinariness. Applying a practice-oriented perspective (Kuutti & Bannon, 2014)—that is, long-term engagement with users in natural, in-situ settings, such as through ethnographic approaches—is especially promising for capturing the ordinariness of experiences.

However, even with research methods that are usually not considered as specifically appropriate for accessing ordinary aspects of everyday life, it is possible to reveal insights regarding various nuances of ordinariness. Based on our research in the semiconductor factory, we found narrative methods (as part of our long-term ethnographic research in the factory) valuable in gaining insights on nuances of ordinariness. Narrative methods representing a retrospective approach are typically applied to gather reports on specifically memorable experiences (Meneweger, Wurhofer, Obrist, Beck, & Tscheligi, 2014). Hereby, participants were encouraged to report specific experiences that are particularly relevant for them (Wright & McCarthy, 2010). The openness of narrative approaches enable participants to extensively express personal reflections and thoughts, as well as reveal a broader spectrum of experiences (being more or less ordinary), such as descriptions of ordinary reoccurring situations (Flick, 2000; Meneweger et al., 2015). Other methods (e.g., diary studies, day reconstruction), where users are encouraged to report and reflect on concrete experiences of specific interactions or situations (e.g., after having used a device or prototype; Karapanos et al., 2009), may also contain broader insights on nuances of ordinary experiences. In particular, a research goal could be to explore user experience beyond concrete events. Particularly when recollecting long-term experiences, which are created cumulatively, researchers must consider that unordinary experiences may overshadow ordinary experiences, especially as those do not require much attention during the interaction.

We propose the following questions be raised whenever investigating the ordinariness of experience: (a) How does this method deal with the ordinariness of experiences? and (b) How can different nuances of ordinariness be addressed? Our conception of ordinariness offers the opportunity to guide the application of certain methods to explore ordinariness of experience, regarding data gathering processes as well as analysis approaches. For example, interview guidelines can be set up to explore more deeply the different ways of encountering

technology described in Figure 1. Further, data gathered in interview studies and ethnographic observations can be structured and organized based on these levels.

Regarding operationalizing user experience conceptions, user experience is often reduced to factors that are addressed with a technology (e.g., fun, enjoyment, anger, safety, trust; Bargas-Avila & Hornbaek, 2011). At this point, one can distinguish factors along the range of ordinariness of experience. For example, factors like fun or enjoyment are often related to specific situations, meaning that users can relate the situations where they experienced fun or enjoyment because those can be perceived as unordinary. Nevertheless, other factors are not constantly in the attention of a user (e.g., safety or trust). Users might have problems telling a story about a specific situation evoking a feeling of safety or trust simply because they do not pay specific attention to the feeling of trust or safety (i.e., when a technology is running properly). However, whether users are able to report these experiences significantly depends on the context of the interaction (e.g., if an interaction is situated in a safety-critical situation like cars, feelings of safety may be well communicable). Additionally, temporal conditions are influential regarding the shift from extraordinary to ordinary experience, for instance, as experiences with new technologies evolve over time (Karapanos et al., 2009). Thus, users may pay initial attention to trust as a component of the experience, whereas after several trustful interactions, it might become less prominent in the users' experience and thus less memorable. Being aware of the ordinariness of experiences helps researchers decide on specific methods to employ. Independent from how data were gathered, the different ways of encountering technology and related attributes (i.e., repetitive and initial, frequent and infrequent, everyday and intervening), can be specifically anchor the search within the data.

User Experience Design

"The design of everyday things is in great danger of becoming the design of superfluous, overloaded, unnecessary things." (Norman, 1988/2002, p. 293)

This quote from Norman (1988/2002) pointed out what we consider a challenge for design: What kind of experience should designers aim for? In other words, what is considered a good or positive experience? The characteristics of good or positive experiences differ largely. Is it the extraordinary, exceptional experience, such as unpacking a new iPhone, that leads to a good experience with technology? Or is it the continuous, unexcited ordinary experience (e.g., the familiar feeling of touching the display during an ordinary e-mail checking activity on the phone) that is considered as a desired experience? It is not surprising that a great deal of current user-experience research activities focus on unordinary experiences due to the contexts that are investigated (e.g., home, leisure, culture). Certainly, there is also research addressing everyday, ordinary experiences, primarily in design research (e.g., Desjardins & Wakkary, 2013; Norman, 1988/2002; Wakkary, 2009). However, these differences still play a marginalized role when it comes to design and user experience research. Emphasizing ordinariness in the scientific discourse provides a link between different contexts and appropriate methods. We posit that, with the increased ubiquity of computing, interactions that are in the background of users' attention (i.e., peripheral interaction; Bakker et al., 2015) gain increasing importance. However, users are required to understand and learn how to interact with a system before the interaction disappears from the user's attention (Bødker, 2006). Thus, the experience addressed at any specific moment may differ

from the first encounter of an interactive artifact to long-term use; yet each of these needs to be articulated to allow reflection on the design (e.g., Dalsgaard & Halskov, 2012) and usage.

We are aware that different nuances of ordinariness are addressed in design practice, although often implicitly. The tacit knowledge of interaction designers (e.g., Moggridge & Atkinson, 2007) may help them design a specific, more or less ordinary, experience. However, it would be beneficial if the respective experiences could explicitly be articulated along the continuum of ordinariness in order to allow researchers and designers to discuss, learn from, understand, and finally improve interactions. Although experiences that are in the background of people's attention (Forlizzi & Ford, 2000) and part of their everyday life (Wright & McCarthy, 2010) have been mentioned in previous work, designing for ordinary experiences has not explicitly been addressed in the research literature. The conceptualization of experience in terms of ordinariness, as proposed in this article (i.e., ranging from ordinary to unordinary ways of encountering technology), is one means of facilitating this articulation by depicting the dynamics and characteristics of ordinariness, as well as by providing the respective vocabulary, such as the earlier proposed characteristics. We advocate for experience-centered design activities (for the factory and beyond) to address the following: (a) designing for positive, compelling, and outstanding experiences; (b) designing for ordinary experiences happening in the background of people's attention; and (c) designing for experiences that meander continually between the ordinary and unordinary along a temporal trajectory.

CONCLUSIONS

Recognizing the distinction between outstanding and remarkable experiences (i.e., unordinary) and interactions that are unremarkable and happening in the background of people's attention (i.e., ordinary) in various everyday work experiences certainly is an important aspect of user experience research. Thus, interacting with systems embedded in everyday practices, for instance in a work context, has to be conceived as ranging from unordinary to ordinary experiences. For example, interactions cannot and should not evoke solely positive unordinary experiences. With this article, we show that mundane experiences might also be good and the intended experiences evoked by interactive artifacts. Especially in everyday work engagement, good and desired experiences are often those that do not attract people's attention and are less cognitively demanding. Promoting sensitivity for ordinary experiences, however, does not mean that ordinary experiences are superior to unordinary ones or vice versa. Thus, design activities can reach from addressing compelling and outstanding experiences to designing for ordinary experiences happening in the background of people's attention. It is the arrangement along the various nuances of ordinariness that an interactive artifact may address and be specifically tailored to the purpose of the design. We aimed to promote sensitivity in research and design for this conceptual distinction by highlighting ordinary user experiences. We further propose that ordinariness of experiences should be considered when defining user experience goals within an experience-centered design process, in terms of which nuances of ordinariness should be addressed with the designated design activity.

The semiconductor factory context, which is the basis for this reflection on ordinary experiences, provides rich, yet simultaneously limited, insights. It is rich in that its interactions are both ordinary and unordinary. It is limited as a specific work context that barely allows

transferral to work contexts beyond semiconductor or other manufacturing, let alone to leisure settings or contexts. Although we cannot provide evidence for a generalization, the lens of ordinary experiences can be taken as a basis to analyze experiences in other (e.g., work, leisure) contexts. It is likely that ordinariness can be found everywhere, though to a differing extent. Ordinary experiences might be an integral and important part of people's everyday experiences with technology, as the heterogeneous nature of interactions, settings, and contexts is likely to result in diverse nuances of ordinariness. The main goal of this work is, consequently, to raise awareness for ordinary experience. It represents the challenging endeavor of theoretically framing and describing ordinary experiences with technology by means of a specific use case, that is, factory work.

Our theoretical conception is not a fully elaborated theoretical framework yet. Necessary future work will address the aforementioned limited breadth of application, that is, we strive to broaden the notion beyond factory work. In terms of the depth of the elaborated framework, future studies will reveal details that are not covered by this first exploration, including an enhanced vocabulary to describe the nuances of the ordinary. However, even with these limitations, this reflection on nuances of ordinariness is needed, on one hand to better understand the spectrum of human experiences with technology, and on the other hand, to allow design practitioners to integrate this knowledge deliberately within design activities.

Our research provides a complementary conception and description of experiences with technology based on a practice-oriented perspective, which encompasses not only outstanding, extraordinary experiences but also ordinary, unremarkable experiences. By explicitly including ordinary experiences within the discussion on user experience, we emphasize a frequently overlooked perspective on user experience. As everyday, ordinary interactions with technology play a crucial role in shaping people's experience, a way to theoretically describe them with regard to user experience is required. The conception of ordinariness provides a basis to reflect on, research into, and design for nuances of ordinariness in multiple application areas as well. In particular, we encourage investigating how ordinariness of experience can be characterized in other application and context areas, or how specific methods can be advanced to better access nuances of ordinariness. Further, deeper theoretical discussions, for example, with regard to conceptions like learnability, affordance, or habituation, as well as cognitive psychology in general, will further increase knowledge on the ordinariness of experiences.

IMPLICATIONS FOR THEORY AND APPLICATION

By promoting sensitivity for the ordinariness of experiences—ranging from ordinary to unordinary experiences—that users may have while interacting with technology, we contribute toward a more comprehensive conception of user experience in research and design. Beyond the use case of a factory, this might be also relevant for other work contexts as well as for home or mobile contexts. On one hand, our conception allows including unobtrusive, peripheral, or ambient interactions in the discussion surrounding user experience and thus paving the way for more elaborated and explicit approaches to research and design for ordinary experiences. On the other hand, our conception of ordinariness facilitates the refinement of methods to empirically assess and explore experiences—both generally and specifically related to unobtrusive, peripheral, or ambient interactions that are intended to be in the background of the user's

attention. This implies the need to conduct qualitative research, engaging with users in their everyday context, as well as the adoption of practice-oriented research with a focus on user experience. In particular, our conception offers the opportunity to guide the application of certain methods by considering how a method deals with the ordinariness of experiences and how the method addresses different nuances of ordinariness.

ENDNOTES

1. Bødker (2015) distinguished between three waves of HCI: (a) the first wave of HCI was driven by cognitive science and human factors and mainly focused on systematically studying the user through formal methods; (b) the second wave's focus shifted to (group) work settings considering the context of use as relevant dimension; and (c) the third wave broadened its focus beyond work settings to homes and other leisure domains.
2. The applied interview approach specifically addressed memories of workers (after deploying the robots). Certainly, memory effects need to be taken into account (Norman, 2009). Thus, our conception on ordinary experiences (based on the previous study applying a retrospective method) refers to the reflective level of humans' experiences.
3. We translated the quotes from German into English and gave them to an English native speaker for proof reading.

REFERENCES

- Abrahams, R. D. (1986). Ordinary and extraordinary experience. In V. W. Turner & E. M. Bruner (Eds.), *The anthropology of experience* (pp. 45–73). Urbana, IL, USA: University of Illinois Press.
- Addams, C. (n.d.). Charles Addams quotes. Retrieved from https://www.goodreads.com/author/quotes/52274.Charles_Addams
- Adler, P. S., & Winograd, T. (1992). The usability challenge. In P. S. Adler & T. A. Winograd, (Eds.), *Usability: Turning technologies into tools* (pp. 3–14). New York, NY, USA: Oxford University Press.
- Ardito, C., Buono, P., Caivano, D., Costabile, M. F., & Lanzilotti, R. (2014). Investigating and promoting UX practice in industry: An experimental study. *International Journal of Human–Computer Studies*, 72(6), 542–551.
- Bakker, S., Hoven, E., & Eggen, B. (2015). Peripheral interaction: Characteristics and considerations. *Personal Ubiquitous Computing*, 19(1), 239–254.
- Bargas-Avila, J. A., & Hornbaek, K. (2011). Old wine in new bottles or novel challenges: A critical analysis of empirical studies of user experience. In *Proceedings of the 2011 Annual Conference on Human Factors in Computing Systems* (CHI '11; pp. 2689–2698). New York, NY, USA: ACM.
- Björmdal, P. S., & Ralph, M. B. (2014). On the handling of impedance factors for establishing apprenticeship relations during field studies in industry domains. In *Proceedings of the 8th Nordic Conference on Human–Computer Interaction: Fun, Fast, Foundational* (NordiCHI '14; pp. 1107–1112). New York, NY, USA: ACM.
- Blythe, M. A., Overbeeke, K., Monk, A., & Wright, P. C. (2004). *Funology: From usability to enjoyment*. New York, NY, USA: Kluwer Academic Publishers.
- Bødker, S. (2006). When second wave HCI meets third wave challenges. In *Proceedings of the 4th Nordic Conference on Human–Computer Interaction: Changing Roles* (NordiCHI '06; pp. 1–8). New York, NY, USA: ACM.
- Bødker, S. (2015). Third-wave HCI, 10 years later: Participation and sharing. *Interactions*, 22(5), 24–31.
- Brown, J. A. (1954). *The social psychology of industry*. Baltimore, MD, USA: Penguin Books.
- Carroll, J. M. (2004). Beyond fun. *Interactions*, 11(5), 38–40.

- Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York, NY, USA: Harper & Row.
- Dalsgaard, P., & Halskov, K. (2012). Reflective design documentation. In *Proceedings of the Designing Interactive Systems Conference (DIS'12)*; pp. 428–437). New York, NY, USA: ACM.
- Desjardins, A., & Wakkary, R. (2013). Manifestations of everyday design: Guiding goals and motivations. In *Proceedings of the 9th ACM Conference on Creativity & Cognition (C&C'13)*; pp. 253–262). New York, NY, USA: ACM.
- Desmet, P. M., Porcelijn, R., & van Dijk, M. (2007). Emotional design: Application of a research-based design approach. *Knowledge, Technology & Policy*, 20(3), 141–155.
- Dewey, J. (2005). *Art as experience*. New York, NY, USA: Perigree. (Original work published 1934)
- Dourish, P. (2001). *Where the action is: The foundations of embodied interaction*. Cambridge, MA, USA: MIT Press.
- Dourish, P. (2004). What we talk about when we talk about context. *Personal Ubiquitous Computing*, 8(1), 19–30.
- Fallman, D., Kruzeniski, M., & Andersson, M. (2005). Designing for a collaborative industrial environment: The case of the ABB Powerwall. In *Proceedings of the 2005 Conference on Designing for User eXperience (DUX '05; Article 41)*. New York, NY, USA: AIGA.
- Fischer, F. M., Paraguay, A. I. B. B., de Castro Bruni, A., de C. Moreno, C. R., Berwerth, A., Riviello, C., & Vianna, M. M. L. (1998). Working conditions, work organization and consequences for health of Brazilian petrochemical workers. *International Journal of Industrial Ergonomics*, 21(3), 209–219.
- Flick, U. (2000). Episodic interviewing. In W. Bauer & G. Gaskell (Eds.), *Qualitative researching with text, image and sound* (pp. 75–92). London, UK: Sage.
- Forlizzi, J., & Ford, S. (2000). The building blocks of experience: An early framework for interaction designers. In *Proceedings of the 3rd Conference on Designing Interactive Systems (DIS'00)*; pp. 419–423). New York, NY, USA: ACM.
- Garfinkel, H. (2015). *Studies in ethnomethodology*. Englewood Cliffs, NJ, USA: Prentice-Hall. (Original work published 1967)
- Gaver, W. W., & Martin, H. (2000). Alternatives: Exploring information appliances through conceptual design proposals. In *Proceedings of the 2010 Annual Conference on Human Factors in Computing Systems (CHI'00)*; pp. 209–216). New York, NY, USA: ACM.
- Graham, C., & Rouncefield, M. (2007, November). *Photos as mundane technology*. Presentation at the Workshop on Social Interaction and Mundane Technologies, Melbourne, Australia.
- Hassenzahl, M. (2010). Experience design: Technology for all the right reasons. *Synthesis Lectures on Human-Centered Informatics*, 3(1), 1–95.
- Hassenzahl, M., Diefenbach, S., & Göritz, A. (2010). Needs, affect, and interactive products: Facets of user experience. *Interacting with Computers*, 22(5), 353–362.
- Hedman, J., & Gimpel, G. (2010). The adoption of hyped technologies: A qualitative study. *Information Technology and Management*, 11(4), 161–175.
- Hull, R., Reid, J., & Kidd, A. (2002). *Experience design in ubiquitous computing* (Technical Report No. HPL-2002-115). Retrieved from Hewlett-Packard Company at <http://www.hpl.hp.com/techreports/2002/HPL-2002-115.pdf>
- IEE Colloquium. (1991). *IEE colloquium on "HCI: Issues for the factory"* (Digest No.047). London, UK: ICON Group International.
- International Organization for Standardization [ISO]. (1998, March). *Ergonomic requirements for office work with visual display terminals (VDTs)—Part 11: Guidance on usability* (ISO Standard No. 9241-11). Geneva, Switzerland: ISO.
- Ju, W., & Leifer, L. (2008). The design of implicit interactions: Making interactive systems less obnoxious. *Design Issues*, 24(3), 72–84.
- Kaasinen, E., Roto, V., Hakulinen, J., Heimonen, T., Jokinen, J. P., Karvonen, H., Keskinen, T., Koskinen, H., Lu, Y., Saariluoma, P., Tokkonen, H., & Turunen, M. (2015). Defining user experience goals to guide the design of industrial systems. *Behaviour & Information Technology*, 34(10), 976–991.

- Karapanos, E., Zimmerman, J., Forlizzi, J., & Martens, J.-B. (2009). User experience over time: An initial framework. In *Proceedings of the 27th International Conference on Human Factors in Computing Systems* (CHI '09; pp. 729–738). New York, NY, USA: ACM.
- Kuutti, K. (2010). Where are the Ionians of user experience research? In *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries* (NordiCHI '10; pp. 715–718). New York, NY, USA: ACM.
- Kuutti, K., & Bannon, L. J. (2014). The turn to practice in HCI: Towards a research agenda. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '14; pp. 3543–3552). New York, NY, USA: ACM.
- Logan, R. J. (1994). Behavioral and emotional usability: Thomson consumer electronics. In M. E. Wiklund (Ed.), *Usability in practice: How companies develop user friendly products* (pp. 59–82). San Diego, CA, USA: Academic Press Professional, Inc.
- Lu, Y., & Roto, V. (2015). Evoking meaningful experiences at work: A positive design framework for work tools. *Journal of Engineering Design*, 26(4-6), 99–120.
- Luoju, S. (2012). Integrating momentary and long-term UX: A theoretical approach. In *Proceedings of the 24th Australian Computer-Human Interaction Conference* (OzCHI '12; pp. 353–356). New York, NY, USA: ACM.
- May, G., Taisch, M., Bettoni, A., Maghazei, O., Matarazzo, A., & Stahl, B. (2015). A new human-centric factory model. *Procedia CIRP*, 26, 103–108.
- McCarthy, J., & Wright, P. (2004). *Technology as experience*. Cambridge, MA, USA: MIT Press.
- Meneweger, T., Wurhofer, D., Fuchsberger, V., & Tscheligi, M. (2015). Working together with industrial robots: Experiencing robots in a production environment. In *Proceedings of the 24th IEEE International Symposium on Robot and Human Interactive Communication* (RO-MAN'15; pp. 833–838). Kobe, Japan: IEEE.
- Meneweger, T., Wurhofer, D., Obrist, M., Beck, E., & Tscheligi, M. (2014). Characteristics of narrative textual data linked to user experiences. *Extended Abstracts on Human Factors in Computing Systems* (CHI EA '14; 2605–2610). New York, NY, USA: ACM.
- Michael, M. (2003). Between the mundane and the exotic time for a different sociotechnical stuff. *Time & Society*, 12(1), 127–143.
- Moggridge, B., & Atkinson, B. (2007). *Designing interactions* (Vol. 14). Cambridge, MA, USA: MIT Press.
- Nakatsu, R., Rauterberg, M., & Vorderer, P. (2005). A new framework for entertainment computing: From passive to active experience. In *Proceedings of the 4th International Conference on Entertainment Computing* (ICEC'05; 1–12). Berlin, Germany: Springer.
- Noor, S. M., & Abdullah, M. A. (2012). Quality work life among factory workers in Malaysia. *Procedia—Social and Behavioral Sciences*, 35, 739–745.
- Norman, D. A. (1998). *The invisible computer: Why good products can fail, the personal computer is so complex, and information appliances are the solution*. Cambridge, MA, USA: MIT Press.
- Norman, D. A. (2002). *The design of everyday things*. New York, NY, USA: Basic Books. (Original work published 1988)
- Norman, D. A. (2009). The way I see it: Memory is more important than actuality. *Interactions*, 16(2), 24–26.
- Odom, W., & Wakkary, R. (2015). Intersecting with unaware objects. In *Proceedings of the 2015 ACM SIGCHI Conference on Creativity and Cognition* (C&C '15; pp. 33–42). New York, NY, USA: ACM.
- Roto, V., Law, E., Vermeeren, A., & Hoonhout, J. (2011). User experience white paper: Bringing clarity to the concept of user experience. Retrieved from <http://www.allaboutux.org/files/UX-WhitePaper.pdf>
- Schaufeli, W. B., Salanova, M., González-Romá, V., & Bakker, A. B. (2002). The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of Happiness Studies*, 3(1), 71–92.
- Tolmie, P., Pycok, J., Diggins, T., MacLean, A., & Karsenty, A. (2002). Unremarkable computing. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '02; pp. 399–406). New York, NY, USA: ACM.

- Tscheligi, M., Meschtscherjakov, A., Weiss, A., Wulf, V., Evers, V., & Mutlu, B. (2012). Exploring collaboration in challenging environments: From the car to the factory and beyond. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work Companion (CSCW '12)*; pp. 15–16. New York, NY, USA: ACM.
- Väättäjä, H., Seppänen, M., & Paananen, A. (2014). Creating value through user experience: A case study in the metals and engineering industry. *International Journal of Technology Marketing*, 9(2), 163–186.
- Village, J., Searcy, C., Salustri, F., & Neumann, P. W. (2015). Design for human factors (dfhf): A grounded theory for integrating human factors into production design processes. *Ergonomics*, 58(9), 1529–1546.
- Wakkary, R. (2009). Feature: Anything is a fridge—The implications of everyday designers. *Interactions*, 16(5), 12–17.
- Weiss, A., Kluckner, P. M., Buchner, R., & Tscheligi, M. (2012, February). *Contextual researches: Challenges and approaches in the factory context*. Presentation at the CSCW Workshop on Exploring Collaboration in Challenging Environments: From the Car to the Factory and Beyond, Seattle, WA, USA.
- Wright, P., & McCarthy, J. (2010). Experience-centered design: Designers, users, and communities in dialogue. *Synthesis Lectures on Human-Centered Informatics*, 3(1), 1–123.
- Wright, P., McCarthy, J., & Meekison, L. (2004). Making sense of experience. In M. A. Blythe, K. Overbeeke, A. F. Monk, & P. C. Wright (Eds.), *Funology* (pp. 43–53). Norwell, MA, USA: Kluwer Academic Publishers.
- Wurhofer, D., Buchner, R., & Tscheligi, M. (2014). Research in the semiconductor factory: Insights into experiences and contextual influences. In *Proceedings of the 7th International Conference on Human System Interaction (HSI '14)*; pp. 129–134. Costa da Caparica, Portugal: IEEE.
- Wurhofer, D., Fuchsberger, V., Meneweger, T., Moser, C., & Tscheligi, M. (2015). Insights from user experience research in the factory: What to consider in interaction design. In J. A. Nocera, B. R. Barricelli, A. Lopes, P. Campos, & T. Clemmensen (Eds.), *Human work interaction design: Work analysis and interaction design methods for pervasive and smart workplaces* (pp. 39–56). Berlin, Germany: Springer-Verlag.
- Wurhofer, D., Meneweger, T., Fuchsberger, V., & Tscheligi, M. (2015). Deploying robots in a production environment: A study on temporal transitions of workers' experiences. In *Proceedings of the 15th IFIP TC 13 International Conference on Human-Computer Interaction (INTERACT 2015)*; pp. 203–220. Cham, Switzerland: Springer.

Authors' Note

We thank Marianna Obrist for her valuable comments and feedback on an early version of this article. The financial support of the Austrian Federal Ministry of Science, Research and Economy and the National Foundation for Research, Technology and Development is gratefully acknowledged (Christian Doppler Laboratory for “Contextual Interfaces”).

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Human Technology
ISSN 1795-6889
www.humantechnology.jyu.fi

DESIGNING A EUSTRESS TOOLBOX: FROM ENTREPRENEUR EXPERIENCES TO AN ONLINE SERVICE

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Abstract: *Stress is typically seen as a negative phenomenon. However, the positive side of stress (i.e., eustress) has the potential to improve well-being, productivity, and innovativeness, thus increasing individuals' daily resources at work. Focusing on eustress could enhance work engagement by turning some of the negatively perceived stressors into positive challenges. We explored this possibility by interviewing 21 Finnish entrepreneurs from various fields regarding their experiences of eustress. Nine of the interviewed entrepreneurs also recorded a eustress diary. Based on thematic analysis of the interview data, six main themes supporting eustress were identified: (a) Self-reflection toward changing the mindset, (b) Organizing work, (c) Stimulating positive pressure, (d) Harnessing a feeling of joy, (e) Mental preparation, and (f) Recovery. A Web-based service, the Eustress Toolbox, was designed to support practicing eustress skills related to the six main themes within the daily lives of the entrepreneurs.*

Keywords: *eustress, positive stress, work engagement, digital services, human-centered design, entrepreneur interviews, qualitative research.*



INTRODUCTION

Stress has been defined as a psychological and physiological state resulting from an imbalance between demands and resources (Lazarus & Folkman, 1984). This term typically refers to negative stress (*distress*), which occurs when an individual perceives that the demands of an external situation (i.e., stressors causing stress) are beyond his or her perceived ability to cope with them (Lazarus, 1966). However, the responses to stressors can also be positive because a stressor can be perceived either as a negative threat or as a positive challenge (Le Fevre, Kolt, & Matheny, 2006).

Positive stress, also known as *eustress*, has gained rather minor attention in the fields of and research in psychology, health technology, and human–computer interaction (HCI). Even though the positive side of stress is not a new concept (Lazarus, 1966; Selye, 1974), relatively few studies focus on eustress (see, e.g., Le Fevre et al., 2006; Simmons & Nelson, 2007) compared to the overall number of stress studies. In this paper, eustress means a positive response to stressors (Le Fevre et al., 2006; Simmons & Nelson, 2007). Although negative stress is a significant issue and causes serious health problems (Chandola, Brunner, & Marmot, 2006; Kivimäki et al., 2006), approaching stress only from this perspective may ignore a remarkable resource for well-being, innovativeness, and productivity.

In this paper, we concentrate on entrepreneurs' experiences of eustress. The term entrepreneur refers to small business owners or self-employed workers. Managing distress and savoring eustress is especially important for entrepreneurs. Entrepreneurship comes with stressful conditions, such as heavy workloads and a high need for achievement (Harris, Saltstone, & Fraboni, 1999; Langan-Fox & Roth, 1995), along with a personal commitment to the company and the risk of failure (Greenhaus & Callanan 1994). A lower degree of structure, predictability, and support are characteristic as well of the entrepreneur's work (Greenhaus & Callanan, 1994).

Despite the stressors of entrepreneurial work, not all entrepreneurs are reporting higher levels of negative stress compared to organizationally employed people (Baron, Franklin, & Hmieleski, 2016; Rahim, 1996). Cardon and Patel (2015) elaborated that the attitude toward stress, and thus the self-evaluation of it, might differ because the effect of stress on one's income can be positive, even while stress can impact negatively one's physical health. Baron et al. (2016) stated that psychological capital, coping, and effective stress management are critical factors influencing the stress experience and, potentially, the survival of companies. In addition to approaching stress from the perspective of managing distress, we believe that learning to savor eustress can support these factors and thus, positively affect one's overall well-being.

Entrepreneurs often have the freedom to arrange their working schedules and ways of working. This freedom creates the possibility and need for balancing one's time (both at work and in personal life) to achieve the intended results efficiently and to ensure time for recovery from work. We chose to concentrate on entrepreneurs' experiences of eustress at work because the line between work and free time is not always clear in the daily lives of entrepreneurs.

The objective of this research was to increase knowledge of the positive side of stress and the entrepreneurs' ways of fostering it and, based on the qualitative data, present a Web-based service prototype to stimulate eustress in the daily work of entrepreneurs. Overall, we aimed at contributing to the design for well-being and the positive approach to design, which

are growing research interests in the field of HCI (Calvo & Peters, 2014; Desmet & Hassenzahl, 2012; Desmet, Pohlmeier & Forlizzi, 2013).

The research questions that guided the various aspects of our study are

1. What ways of thinking and working help entrepreneurs to identify and feel eustress (i.e., positive stress)?
2. How could a Web-based service be designed to support entrepreneurs in developing eustress skills in their daily lives?

Based on the findings related to Research Questions 1 and 2, we present the resulting Eustress Toolbox, with the aim of providing practical information on eustress and the means to achieve it. Focusing on the positive side of stress builds understanding of one's well-being at work and may empower people to view stress from the beneficial perspective. We expect the results to be useful for practitioners and other members of the HCI community who are interested in the new approaches and studies related to digital services fostering holistic well-being in general and supporting the opportunity to experience eustress in particular.

The paper first presents related research on eustress and digital services designed to enhance well-being. We then elaborate on how eustress relates to other positive work-related concepts, and work engagement in particular. Second, our design process, methods, and participants are described. The results describe briefly the central findings related to entrepreneurs' experiences of fostering eustress (see more on experiences related to technology in Heikkilä, Ainasoja, & Oksman, 2015) and focus more on introducing the Eustress Toolbox. We conclude this paper with discussion of the findings and suggestions for future research.

RELATED RESEARCH

In this section, we present related work on eustress and digital services developed for supporting well-being. Relevant design frameworks also are introduced. The related work on eustress provides background understanding of the concept and its relationship to more familiar positive work-related concepts, and work engagement in particular. The sections related to digital services supporting well-being and design frameworks connect the related research more tightly to HCI and relevant design principles and recommendations.

Eustress: Stress as a Resource

The positive side of stress was recognized already a few decades ago (Lazarus, 1966; Selye, 1974). The term eustress was introduced by Hans Selye (1974), who distinguished two sides of stress: the harmful side (distress), caused by negative stressors, and the beneficial side (eustress) that include positive emotions. He suggested that one can learn to react to stressors with positive emotions, such as gratitude, hope, or good will, which is likely to maximize eustress and minimize distress. Even before Selye, Richard Lazarus (1966) proposed that the cognitive response to stressors can also be positive, leading to positive emotions, such as a feeling of fulfillment.

Despite these early notions, the theories of stress have approached stress primarily as a negative phenomenon or have focused on the negative impacts of stress when studying the

application of these theories. The various theories of work stress have emphasized, for example, the relationship between job demands and job control (the demand–control model; Karasek & Theorell, 1990), the imbalance between perceived efforts and rewards at work (the effort–reward imbalance model; Siegrist, 1996), or the processes of appraisal and coping (the cognitive stress theory; Lazarus & Folkman, 1984). The latter belongs to the transactional theories of stress that acknowledge the role of cognitive and emotional processes in stress experiences. More specifically, Lazarus and Folkman (1984) emphasized that the individual’s resources and ability to cope define the stress experience.

The current definitions of eustress are based mainly on the transactional stress theories, which emphasize the individual interpretation of stressors. In other words, individual responses to stressors can be positive or negative: A stressor can be perceived as a negative threat or a positive challenge (Le Fevre et al., 2006). Consequently, eustress is defined as a positive response to stressors and distress as a negative response to stressors (Le Fevre et al., 2006; Simmons & Nelson 2007). Thus, the stress response is determined by the perception of demand related to the stressors, but also by the perception of other contextual characteristics, such as the source, timing, and desirability of a stressor and one’s perception of having control over it (Le Fevre et al., 2006). According to Simmons and Nelson (2007), eustress and distress are not the two ends of the same continuum, but rather distinct qualitative constructs. This means that a stressor may not only be interpreted either as positive or negative, but it may have both outcomes. Positive and negative responses to a stressor are complex and mixed, and they manifest themselves in different physiological, psychological, and behavioral indicators. However, the eustress experience is characterized with positive emotions, attitudes, and behaviors, such as a feeling of joy, contentment, or excitement, as well as perceiving the situation as meaningful, manageable, or engaging, to mention some of the indicators listed by Simmons and Nelson (2007).

In addition to minimizing distress, savoring eustress has been suggested as having the potential for increasing the well-being of an individual (Hargrove, Nelson, & Cooper, 2013; Simmons & Nelson, 2007). Hargrove et al. (2013) proposed three means for leaders to encourage eustress in their employees: offering meaningful work, encouraging mindfulness at the workplace, and supporting employees in understanding and embracing their capacity to meet challenging stressors. Moreover, they viewed the match between a person’s skills and the demands of the task as critical. Because the means for approaching stressors are based on self-leadership, they can be assumed to suit entrepreneurs too.

Although experiencing eustress may enhance well-being, an excess of eustress can lead to exhaustion (Hargrove et al., 2013). Therefore, the need to recover from eustress is equally important. Recovery and detachment from work stressors of both kinds can be supported, for example, by developing mindfulness, acceptance, and self-regulation skills (Sonnentag & Fritz, 2015).

Although the terms eustress and positive stress are not often used as such in research, in recent approaches to stress the positive impacts that job conditions may have on well-being are recognized. For example, the job demands–resources model (Schaufeli & Bakker, 2004) stated that job demands can boost work engagement when sufficient resources are available. Experiencing demands such as high time pressure and/or a high workload has been viewed as having the potential to lead to the development of self-efficacy and resilience when adequate resources and recovery between exposures are available (Ilies, Aw, & Pluut, 2015).

Eustress is closely connected to more familiar positive work-related concepts, such as flow experience and work engagement. Experiencing eustress can culminate in flow (Hargrove et al., 2013), in which the individual is extremely focused on the work task (Csikszentmihalyi, 1990). Work engagement is defined as a positive, relatively stable, affective–motivational state of fulfillment at work (Schaufeli, Salanova, González-Romá, & Bakker, 2002). It refers to a persistent state that is not focused on any particular object, event, or individual (Schaufeli & Bakker, 2004). This distinguishes it from eustress or distress, which are seen as short-term responses to stressors (Fevre et al., 2006; Simmons and Nelson, 2007). However, the relationship of eustress and work engagement is not comprehensively elaborated in the literature. The definitions of eustress and work engagement are intertwined and may support each other in several ways. According to the holistic stress model (Simmons & Nelson, 2007), engagement is seen as one positive response to stressors among other attitude indicators, such as hope, meaningfulness, and manageability. On the other hand, the HRD (human resource development) eustress model (Hargrove, Becker, & Hargrove, 2015) presented engagement as one positive outcome of eustress.

In this paper, we focus on eustress, as it has the potential to empower people to view stress from a beneficial perspective. This, in turn, can potentially build personal resources and affect the more stable state of work engagement.

In the field of positive psychology, a shift toward recognizing the positive has been called for in many areas. Thus, eustress is seen as an interesting topic for research. As positive psychology researchers explore health as the presence of the positive—and not only as the absence of the negative (Seligman & Csikszentmihalyi, 2000)—then stress research is seen benefiting from a holistic view that includes eustress (Nelson & Cooper, 2005). Although the literature sheds light on eustress as a concept, more empirical research is needed to understand the everyday experiences of eustress and ways to achieve it. We believe that approaching stress also as a resource and learning to react to stressors in a positive way may be especially useful for preventing distress-related problems of entrepreneurs, who often have to cope with high time demands and pressure.

Well-being Through Digital Services

Digital services are being used increasingly to support health and well-being, including tackling mental health and stress symptoms. Due to limited resources, traditional public health and clinical interventions cannot provide early prevention and health promotion to all people with early-stage health or mental health concerns. Digital interventions provide a scalable means for distributing health promotion and well-being services to a wide range of people. They enable affordable, anonymous, and self-paced access to well-being services with increased fidelity in intervention delivery (Portnoy, Scott-Sheldon, Johnson, & Carey, 2008). Web-based health programs have been proven effective and many of them are as effective as face-to-face programs for a wide variety of health problems, including depression, anxiety disorders, smoking, and alcohol abuse (Cunningham, Gulliver, Farrer, Bennett, & Carron-Arthur, 2014).

Several Web-based programs have been developed for managing mental health symptoms and stress among employees (Stratton et al., 2017). For example, Hasson, Anderborg, Theorell, and Arnetz (2005) presented a Web-based program consisting of stress monitoring, cognitive

exercises, and a chat option for clients' stress management. They found that during the 6-month program, employees' ratings of their stress management ability, sleep quality, mental energy, concentration ability, and social support improved. In a study by van Straten, Cuijpers, and Smits (2008), a 4-week Web-based program for depression, anxiety, and work-related stress resulted in reduced symptoms of depression and anxiety, but less pronounced effects on stress.

In addition to Web-based programs, mobile applications can be utilized in delivering health promotion programs. Ahtinen et al. (2013) presented a mobile application for stress management based on acceptance and commitment therapy (ACT). The application used audio and text exercises to teach the users ACT-based skills, including mindfulness and acceptance. In a month-long pilot study with 15 users, increases in satisfaction with life and decreases in experienced stress were found. Ly, Asplund, and Andersson (2014) studied the effectiveness of an ACT-based stress management program delivered via a mobile application. The program consisted of six weekly modules containing short audio lectures, texts, and exercises on stress and the principles of ACT. In a randomized controlled trial with middle managers, the application was found to decrease stress and increase general health.

Additionally, positive psychology approaches are being incorporated into digital interventions aimed at improving psychological well-being. Ouwenel, Le Blanc, and Schaufeli, (2013) developed an online program intended to improve positive emotions, self-efficacy, and work engagement through happiness, goal-setting, and resource-building exercises. In a controlled trial, improvements in positive emotions and self-efficacy were found, but not in work engagement. However, additional analyses revealed improvements in work engagement among those who scored low at the beginning of the study. Luthans, Avey, and Patera (2008) developed a Web-based training program for increasing positive psychological capital, namely hope, self-efficacy, optimism, and resiliency. The program consisted of two 45-minute sessions that included videos, narrated PowerPoint presentations, and self-reflection exercises. A brief study found improvements in psychological capital in the intervention group compared to a control group. Mitchell Stanimirovic, Klein, and Vella-Brodrick (2009) developed a 3-week Web-based positive psychology intervention focusing on personal strengths. In their 3-month study, the intervention was compared to a problem-solving intervention and a placebo control; small but significant effects in well-being were found in the strengths intervention. The attrition in the study was high, with 34% of participants completing the strengths intervention but only 15.5% of participants completing the problem-solving intervention. The authors hypothesized that the difference in adherence to the interventions may have been caused by the fact that the strengths intervention focused on positive aspects whereas the problem-solving intervention focused on problems.

Despite active research in the fields of stress management and employee wellness, it seems that achieving large and sustained improvements in stress management and positive work-related skills, such as work engagement, are challenging. However, a large majority of studies so far have approached the issue from a negative perspective, and positive approaches have emerged only in recent years (e.g., Orsila, Luukkaala, Manka, & Nygård, 2011). Notably, to our knowledge, no Web-based interventions focusing specifically on eustress exist.

Finally, we consider digital services promising for supporting entrepreneurs as they are inexpensive to distribute, can be tailored to various needs, do not require appointments or occupational health care, and can be used independent of time and place. Combining Web and mobile technologies ensures that most users can find ways to incorporate the tools into

their daily lives. Digital services may also provide a feel of having a virtual community of peers, which entrepreneurs often lack.

Design Frameworks

The challenges of digital interventions include low uptake and high attrition rates that hinder the effectiveness of the interventions (Eysenbach 2005). To address these concerns, digital intervention designers have developed frameworks and guidelines to steer the development of new services. In particular, the need to identify and address end-user perspectives in intervention design has been acknowledged. Yardley Morrison, Bradbury, and Muller (2015) introduced the person-based approach to intervention development, which emphasizes understanding and incorporates the perspectives of the target users at every step of the design process, that is, adopting a human-centered approach in intervention design. The design process involves in-depth qualitative research with target-group users to develop guiding principles. The guiding principles state the key objectives of the intervention and outline the key features required to achieve each objective. A prototype is initially tested with end users to evaluate the acceptability, attractiveness, persuasiveness, ease of use, and feasibility of the prototype. After improvements, the prototype may be tested by asking users to use the intervention on their own, which enables them to try out behavioral changes.

Yardley et al. (2015) listed guiding principles that are common to many interventions, drawn from the self-determination theory. The principles address three key design objectives: (a) promoting user autonomy by providing user choice, when possible; (b) promoting user competence by providing a clear structure and guidance, examples, stories modeling overcoming barriers, graded goal-setting, minimizing conscious effort, and lifestyle disruption, when possible; and (c) promoting positive emotional experience and a sense of relatedness through several features. The features include using positive language; giving a rationale for advice; acknowledging and addressing concerns; ensuring all communications provide something interesting, enjoyable, relevant, and helpful to the user; providing immediately rewarding feedback; and following best practice to maximize accessibility, usability, and trust.

The persuasive systems design model (PSD; Oinas-Kukkonen & Harjumaa, 2009) is a framework for designing behaviorial-change-supporting technologies. The model divides persuasive features into four categories: (a) primary task support, which consists of seven techniques, including reduction of user effort, tunneling the user through a process, self-monitoring, and rehearsal, (b) dialogue support, which consists of seven techniques, including reminders, rewards, and suggestions, (c) system credibility support, which consists of eight techniques, including trustworthiness, surface credibility, and real-world feel, and (d) social support, which consists of seven techniques, including social learning, social facilitation, and recognition. Research suggests that persuasive features can increase adoption and engagement in Web-based interventions (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012).

Both frameworks have several recommendations in common, that is, providing a clear structure and guidance through the program, minimizing conscious user effort, social modeling and learning from others, providing ways to monitor progress, and giving rewarding feedback. In addition, trust is emphasized in both frameworks, which is an important aspect to consider in health-related digital services. These recommendations were adopted as guiding principles in the design of the Eustress Toolbox.

DESIGN PROCESS AND METHODS

The design process of our study followed a human-centered design approach (International Organization for Standardization [ISO], 2010) and proceeded from a two-phased collection of user data to designing a prototype of the Eustress Toolbox Web service (see Figure 1). The collection and analysis of user data were conducted by four researchers of a multidisciplinary team having expertise in psychology, HCI, adult education, and business. We conducted our study with a qualitative approach to gain deeper understanding of the eustress experiences and ways to foster eustress in everyday work lives of entrepreneurs.

In the first phase of the study (entrepreneur interviews), 21 Finnish entrepreneurs were invited to participate through various channels, for example, entrepreneur e-mail lists. The volunteer participant candidates completed a short questionnaire that collected background information, designed explicitly to assure that the data represented diversity in gender, fields represented, and entrepreneurial experience. The study participants comprised 10 females and 11 males, aged 30 to 52 years. Most had a small company with fewer than 10 employees, and these companies were active in fields from consulting and education to building industry and software design. Three entrepreneurs had a larger company with 50–130 employees. The majority of the participants were relatively new entrepreneurs; 12 of them had worked as an entrepreneur for fewer than 5 years. Seven of the entrepreneurs had worked as an entrepreneur at least 10 years. All participants signed an informed consent for participating in the study.

We then interviewed the entrepreneurs in pairs to explore their personal experiences of eustress and their means for “feeding” and maintaining it in their daily lives. A semistructured interview protocol was selected as the research method to enable the participants’ freedom in describing their experiences while maintaining a systematic process for the questions asked.

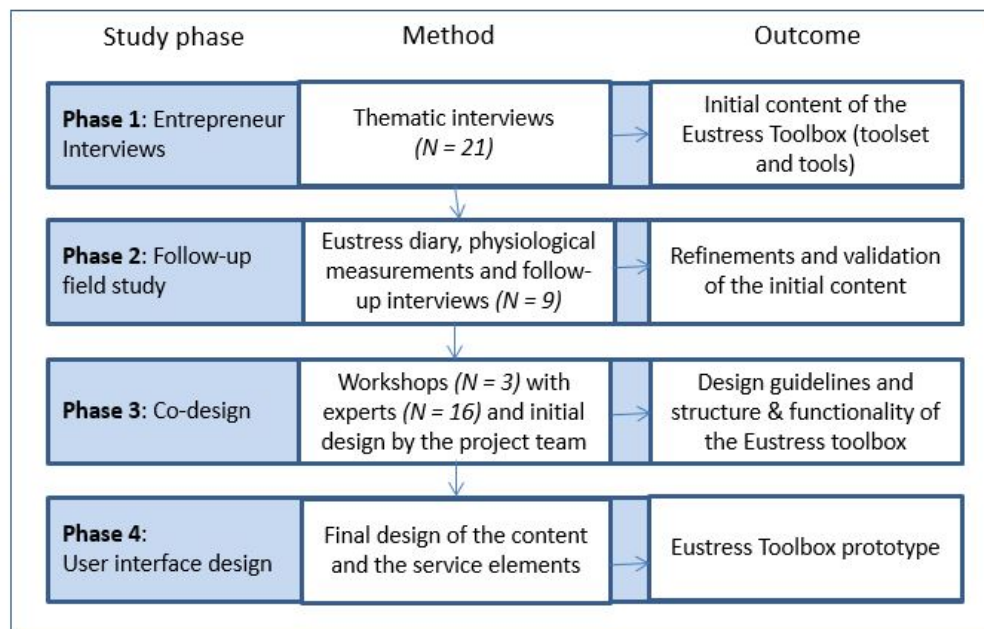


Figure 1. Design procedure describing the study methods and outcomes as Phases 1–4.

The interviews lasted 2 hours and were voice recorded. We conducted them face-to-face at the participant's workplace or other quiet place agreed upon with the participant. All interviews were conducted in Finnish; both the interviewers and the entrepreneurs were competent in the language. The quotes provided in this paper were translated from Finnish to English by a professional translator.

At the start of the interview, each participant was asked to describe his/her current work and daily life as an entrepreneur. The interviewer then briefly explained the term eustress as an experience that occurs when one "enjoys working because of or despite a feeling of pressure." Because eustress has various indicators, enjoyment was selected as a familiar and positive term to encompass positive feelings and attitudes. The interviewee was asked whether he/she has experienced it and whether he/she could recall recent experiences. The participant was asked to elaborate the recent eustress experiences and any feelings or behaviors before, during, and after them, as well as the causes for feeling pressure and enjoyment in the situation. Finally, the interviewer asked how often the entrepreneur experienced eustress, what triggers it, and whether he/she has developed or identified means to achieve it.

The researchers aimed to create rapport with the participants to support them in sharing their experiences freely. However, several means were used to minimize the researchers' impact on the data: The term eustress was explained with a similar description to all participants, the semistructured interview was used as a method instead of a more open approach, and the participants were encouraged to describe concrete examples of their experiences instead of general abstractions.

We analyzed the verbatim transcriptions of the interviews following the steps of thematic analysis defined by Braun and Clarke (2006). Each researcher first read through each interview transcription independently and then the complete body of transcriptions was discussed within the team for clarity of understanding. Then, we systematically coded the parts of the data in which entrepreneurs described the ways of stimulating eustress. The coding was not limited to specific questions; rather, codes were added every time the respondent described a way he/she stimulated eustress, no matter where that took place in the course of the interview. Based on the similarities, we grouped the codes into wider themes. This data-driven analysis led to six main themes that later became the toolsets of the Eustress Toolbox (described in Results section and Table 1). A review and further analysis of these themes produced 24 subthemes that were later employed as the tools in the toolsets and illustrated with entrepreneur quotations chosen from the data. Thus, the basis for the content of the Eustress Toolbox was formed from this first user data collection phase.

The second phase of the user data collection (follow-up field study) was organized with nine participants from the first phase to collect their near-real-time experiences on eustress over the course of a week. We offered the opportunity to participate in this phase of research to all participants, and all who were willing to invest time in participating were accepted. The methods for this phase were designed to support self-reflection of all stress experiences and were recorded daily. We created a subjective diary in a form of a paper booklet. It included a calendar view where the participants assessed the times of experiencing positive or negative stress, their overall feeling in the situation (smileys), and the causes of pressure and enjoyment in the situation. We asked participants to make more detailed notes of the moments in which they felt eustress (that is feeling enjoyment while feeling pressure) and to provide more detailed descriptions on two or three of these situations. In addition to filling in

Table 1. Toolsets, Underlying Needs, and Tools of the Eustress Toolbox Service Drawn from Interviews with Entrepreneurs, Experts, and the Literature.

Toolset	Needs	Tools
Self-reflection and changing the mindset	Need to identify own ways of thinking and working to be able to change them; Need to recognize the signals of stress (positive and negative)	-Self-reflecting on personal thoughts, feelings and actions -Changing the point of view towards the positive -Putting things into perspective -Fostering trust in oneself and the future -Regulating personal resources -Sharing and sparring
Organizing work	Need to manage work in a meaningful and effective way; Need to achieve clarity and avoid tedious routines	-Planning and scheduling -Concretizing tasks and goals -Working together -Breaking routines
Stimulating positive pressure	Need a boost when there is no external demand or pressure	-Creating challenges -Generating time pressure -Seeking out challenging situations
Harnessing a feeling of joy	Need for meaningful and rewarding work to feel happy and motivated	-Seeking out meaningful tasks -Building a positive environment -Enjoying and sharing successes
Mental preparation	Need to face a challenging situation	-Focusing on the essential -Preparing for challenges
Recovery	Need to recover and detach from work	-Taking breaks -Detaching from work -Easing the pace -Releasing pressure -Fostering physical and mental wellbeing -Ensuring sufficient sleep

the diary, the participants conducted a 3-day physiological heart rate variability measurement with the Firstbeat BodyGuard device,¹ which provided data on their physical well-being: stress, recovery, and sleep.

Because physical data on the participants was to be collected in this study phase, we applied for an ethical review from the Ethics Committee of the Tampere Region. The committee identified no barriers for conducting the study. The personal data was treated confidentially in all research phases and anonymized after the data collection.

The data comprising the diary notes and the heart rate variability measurement were elaborated with the nine second-phase entrepreneurs in a new semistructured interview. The goal was to gain deeper knowledge of eustress experiences and to help entrepreneurs learn to recognize these experiences and to interpret their behaviors. The data drawn from each diary and physiological study were addressed chronologically, and the participant was asked to elaborate his/her stress experiences as presented.

The data of the multiple steps in the second phase were used to gain timely and detailed experiences of eustress and to validate the results of the first study phase. When the second-phase data were thematically analyzed, the same six main themes identified in the first data set were present also in the second data set. However, the second-phase analysis allowed us to execute minor refinements to the descriptions and illustrating quotations of the subthemes. As a final step of the second data collection phase, we organized a workshop for all nine participants. In this workshop, these volunteer entrepreneurs shared their approaches to achieving eustress and had an opportunity to learn new approaches from their peers. Although a fruitful experience, the workshop participants did not reveal any new information to augment what had been collected already.

After the two-phased entrepreneur study, we organized three codesign workshops to identify potential design implications and to define a delivery channel for the results. Altogether 16 experts on health technology, well-being, and professional coaching attended the workshops, 4-6 experts at each workshop. In the 2-hour workshops, we first introduced to the experts the six main themes from the user data (with subthemes and illustrative quotations from entrepreneurs). These were presented on posters in the meeting room. After that, we asked each participant to mark down what he/she believed were the most important themes and challenging issues and to generate design implications related to the themes. After this individual task, the experts discussed the issues together within their group. The resulting material of the workshops was analyzed by the project team. The workshops strengthened the potential of the idea of a Eustress Toolbox service, as the participants regarded the data valuable in increasing knowledge of the positive side of stress. Moreover, they advocated for a holistic service, instead of several separate services concentrating on the six explicit themes. The data of the workshops guided the project team in focusing on the following aspects of the service: supporting entrepreneurial work, highlighting peer experiences, and providing means for reflecting and rehearsing new work practices and ways of thinking in one's daily life. Later, these aspects were emphasized in the design guidelines of the service.

In the final step in our research project, we designed the prototype of the Eustress Toolbox online service iteratively in joint workshops within the multidisciplinary project team. The design work started by defining design guidelines, which we formed by utilizing and reflecting upon the materials of both user study phases, the codesign workshops with experts, and the design frameworks described in the literature. We designed the elements and functionality of the eustress service prototype based on the identified guiding principles. The content of the toolsets and the explicit tools of the service were designed based on the entrepreneur experiences (i.e., the analyzed entrepreneur data). In addition, exercises related to the various themes of the toolbox were created. Furthermore, we identified and evaluated third-party mobile and Web applications related to the themes, and those that deemed most suitable to support the goals of the toolbox were included in the service.

The final service prototype was evaluated with four usability experts outside the project team. Based on their evaluations, minor modifications were made to the design.

RESULTS

The Results section is organized to present the results in the order of the study procedure, proceeding from the findings of the user studies to the design of the Eustress Toolbox. The objectives of this research were to provide understanding of the means that help entrepreneurs to recognize and feel eustress and, based on this knowledge, to design a service that introduces methods to stimulate eustress in one's daily life. In the following subsections, we first describe the role of eustress in the entrepreneurs' daily lives and their ways of thinking about and working to foster it; the implications for the Eustress Toolbox follow immediately. After this, we present the design of the Eustress Toolbox, a digital service designed based on entrepreneurs' experiences.

Entrepreneurs' Means of Fostering the Experiences of Eustress in Their Daily Lives, Leading to the Identified Eustress Toolsets

All participants recognized the phenomenon of eustress and considered it beneficial for their work and well-being. Eustress was perceived to be vital for achieving intended results on schedule, for getting the best out of oneself, and for working with a positive and energetic attitude. Eustress was experienced in different situations, but mostly before and during important meetings, such as customer negotiations or a presentation, or when completing important deliveries on a tight schedule. When experiencing eustress, the participants felt themselves enthusiastic and energetic but also able to concentrate and be present in the current moment. The participants reported that it was typical to feel the new stressors as negative at first but later to perceive them as more positive. Examples of eustress presented by participants included starting to feel more confident, being in control of the situation, or seeing the gradual results of one's work.

Based on the entrepreneurs' descriptions of eustress, several factors contributing to the experience could be identified. The following results describe the entrepreneurs' means to simulate eustress in their daily lives.

First, eustress experiences were facilitated by self-reflection on one's thoughts, feelings, and actions (see more about eustress and self-reflection in Tikkamäki, Heikkilä, & Ainasoja, 2016). For example, eustress experiences included descriptions of putting things into perspective, changing one's point of view, and harnessing a feeling of trust—trust in the future, in one's abilities, and the possibility of having an impact. One participant described her insight on the importance of having an impact on her own work in a following way *“You can have an impact on things. It is up to you whether you carry on without doing anything and just complain or whether you actually do something”* (Female, aged 39).

The tools for self-reflection formed the first toolset of the Eustress Toolbox: Self-reflection and Changing the Mind-set. The toolset provided various tools for and examples of the means to change one's point of view, put things into perspective, foster trust, regulate one's resources, and share with and/or bounce ideas off others who are members of the work community, peers, mentors, or close friends or family members.

Second, the entrepreneurs had several daily practices that helped them manage their work better or gain a feeling of things being in control. These methods included, for example, ways to prioritize and schedule work, divide it into smaller pieces, share the work with others, and

make the plans concrete and visible. One participant described the effect of writing a to-do list and making pending tasks visible: *“When you start to write down things, you can see what you need to do. It is no longer this enormous mush in your head that makes you [negatively] stressed”* (Male, aged 41).

The ways to manage and organize one’s work formed the second toolset of the Eustress Toolbox: Organizing Work. Thus, the toolset includes tools for planning and scheduling tasks or projects, concretizing tasks and goals, working collaboratively, and breaking up tedious routines.

Third, the entrepreneurs had various means to challenge themselves and create pressure or a boost for accomplishing tasks. The most typical one was to set a deadline for a task. For others, it meant starting the work shortly before the deadline, rather than early, to enhance the effectiveness of one’s work: *“If I start the task very early, I may do the things too well. If I start later, I do the task at a sufficient level and can forgive the hidden perfectionist in me”* (Male, aged 40).

The means for creating pressure helped to achieve eustress in cases of low or no external pressure. This practice formed the third toolset of the Eustress Toolbox: Stimulating Positive Pressure. The tools provided include ideas for challenging oneself.

Fourth, the feeling of eustress was increased not only by increasing the feeling of pressure but also by harnessing the positive aspects of one’s work. The entrepreneurs harnessed the feeling of joy at work by seeking out meaningful tasks, by building a positive working environment, and by stopping to enjoy and share successes. They described situations where humor, playfulness, acknowledging past successes, and a positive work environment reduced negative stress and helped them in seeing the difficult tasks or parts of them as positive challenges. One participant described his attitude as follows: *“There’s no need to act like a wet blanket, even when you’re talking about major, work-related issues.... A little humor goes a long way”* (Male, aged 51).

The ways to see the positive aspects in one’s work formed the fourth toolset of the Eustress Toolbox: Harnessing a Feeling of Joy. The tools within this toolset including means to recognize the meaningfulness of one’s work, create rewarding and fun conditions for work, and cherish one’s efforts and accomplishments.

Fifth, the entrepreneurs noted that facing the stress in challenging situations was alleviated by mentally preparing for the situation and, when within the situation, keeping one’s mind focused and concentrated on the essential issues. For example, the entrepreneurs visualized the situations beforehand or made lists to clarify the goals in advance of important meetings. Identifying goals or preparing for tasks may not only relieve negative stress, but these processes simultaneously may help in focusing on the most relevant issues in the challenging situation. This process was described by one study participant in this way: *“I make wish lists and to-do lists even for short meetings. Then the things go into your unconsciousness and pop up while in the meeting”* (Male, aged 52).

The means to prepare for a challenging situation and focus on the essential when facing a challenge formed the fifth toolset of the Eustress Toolbox: Mental Preparation. The toolset includes two parts: Focusing on the essential and preparing for challenges.

Finally, most of the entrepreneurs recognized that recovery between work challenges—even positive ones—is extremely important. In the entrepreneur’s world, it is typical for this need to be neglected and to work outside office hours as well. Because of this, it is important to

have reminders and routines for detaching from work. For many study participants, observing the scarcity of the moments of recovery in their well-being measurement was eye-opening.

As a result, many of them committed to new daily practices to increase the number of recouping moments. However, a number of the entrepreneurs had already found good practices to detach from work, for example, by doing something completely different from work tasks. This is characterized by the following comment:

When I start feeling that I only do one thing after another [without enjoyment], I take my dog with me and go into the forest. To detach from the ongoing thoughts, I listen to some hard-core rock from Spotify that I wouldn't listen to otherwise. (Female, aged 42)

Suggestions on ways to recoup and recover from the challenges and timetables of entrepreneurial work formed the sixth toolset of the Eustress Toolbox. The Recovery tools include various means to detach from work both during the workday and on free time.

To summarize, we found six main sets of tools based on the thematic analysis that were used by the entrepreneurs to foster eustress in their daily lives. These were concretized within toolsets: (a) Self-reflection and Changing the Mind-set, (b) Organizing Work, (c) Stimulating Positive Pressure, (d) Harnessing a Feeling of Joy, (e) Mental Preparation, and (f) Recovery. Each toolset addresses different but equally important needs for managing one's work and life. For the Eustress Toolbox to be useful and easily applied, each toolset comprised a number of distinct strategies (i.e., tools). The needs and tools are listed in Table 1.

Eustress Toolbox

From the codesign workshops, it was recognized that the Eustress Toolbox should be provided as a holistic entity rather than as individual tools. To do this, while simultaneously catering to individual needs, an interactive, guided, and personalized approach was conceived. A digital delivery channel, specifically, a Web-based service, was chosen due to its easy availability to most entrepreneurs; its capability for easy integration into the daily lives of users; the potential for guiding, personalizing, and reminding usage; and the possibility to monitor progress and provide feedback.

To guide the design of the Eustress Toolbox, five design guidelines were derived based on insights from the entrepreneur interviews and expert workshops. The person-based approach (Yardley et al., 2015) and the PSD model (persuasive systems design; Oinas-Kukkonen & Harjumaa, 2009) were consulted as formal frameworks to inform the guidelines. The guidelines were

1. *Minimizing user effort.* This is accomplished by dividing the content into standard-format, bite-size pieces, tunneling the user through a program, providing personalized suggestions, and reminding of use. Because entrepreneurs generally struggle with balancing their time, it is crucial that the process for adopting and using new tools is as effortless as possible.
2. *Providing freedom to discover.* To meet varying needs for and triggers in stimulating eustress among entrepreneurs, a free choice among a wide range of techniques is essential. Thus, active discovery of personally suitable tools must be enabled and encouraged.

3. *Enabling follow-up of progress.* Both in the program usage and eustress skills facilitated, the system must allow progress indicators and provide feedback. This aligns with the idea of making planned or completed work visible, which was seen as helpful for optimizing one's time and achieving eustress.
4. *Enabling learning from peers.* Learning about and developing skills that encourage eustress in all aspects of one's professional and personal lives is enhanced when other entrepreneurs' experiences and techniques related to eustress are visible. Sharing and bouncing ideas off peers was perceived as especially important because entrepreneurs often work alone and lack support from colleagues.
5. *Supporting the integration of skills into daily life.* Integrating new skills into the everyday life and turning them into automatic habits requires self-reflection and rehearsal. The process can be supported by providing tools and exercises that enable analyzing how the new skills could fit into one's daily life and rehearsing them until they become habits.

The Eustress Toolbox was designed both to increase understanding of eustress and to help users to develop skills for stimulating eustress in their lives. The goals of the Toolbox were to (a) enable users to familiarize themselves with the phenomenon of eustress and the multiple means to stimulate it, (b) allow users to reflect on their current practices and subtly suggest areas for improvement, (c) guide users through a program of learning new skills, and (d) provide practical tools for integrating the skills into their daily lives.

The structure of the Toolbox was built around the six toolsets derived from the data-collection phase with entrepreneurs. In addition, introduction and ending modules were included (see Figure 2) to provide background information and a possibility to identify the most useful toolsets for oneself, and after using the Toolbox, see one's results in learning new skills. The user's progress was indicated as progress bars, representing the completion of each toolset, and presented on the main page of the Toolbox. To facilitate remembering to use the service, email reminders were sent if the service had not been used for a week.

In the following subsections, the modules of the Eustress Toolbox are presented. As the original service is in Finnish, the texts in the screenshots of the service were translated into English.

Introduction Module

The introduction module (denoted as Start Here) presents the phenomenon of eustress and the background of the Eustress Toolbox service. It also summarizes the structure of the service and provides guidance on how to use it. The introduction module contains a questionnaire for identifying the toolsets most useful to the individual. The questionnaire consists of 21 statements representing the various toolsets drawn from the qualitative interview data. After completing the questionnaire, the user receives a summary and recommendation on the potentially most useful toolsets, which are also denoted in the main view with orange stars (Figure 2).

Eustress Toolsets

Each toolset is constructed in an identical way and contains an introduction, 2–6 tools, and off-line titled "Try out in your daily life" (Figure 3). User progress is indicated also at this level by

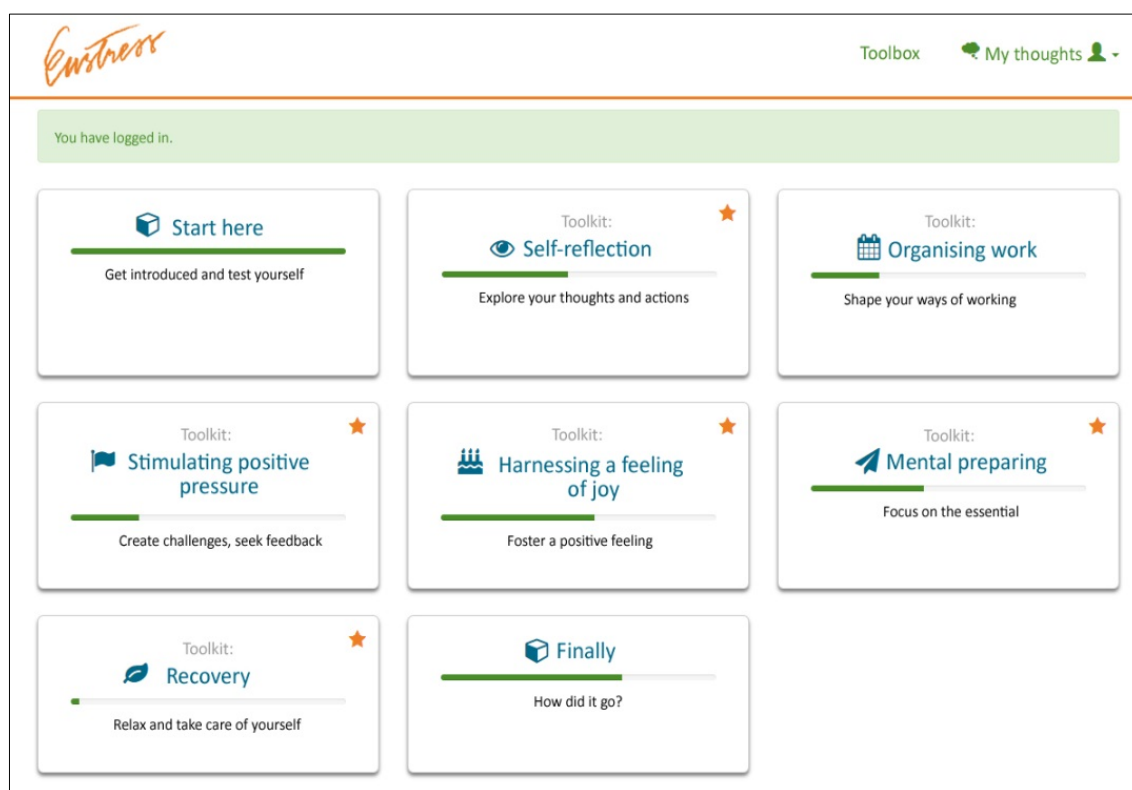


Figure 2. Main view of the Eustress Toolbox: introduction module, six toolsets, and ending module.

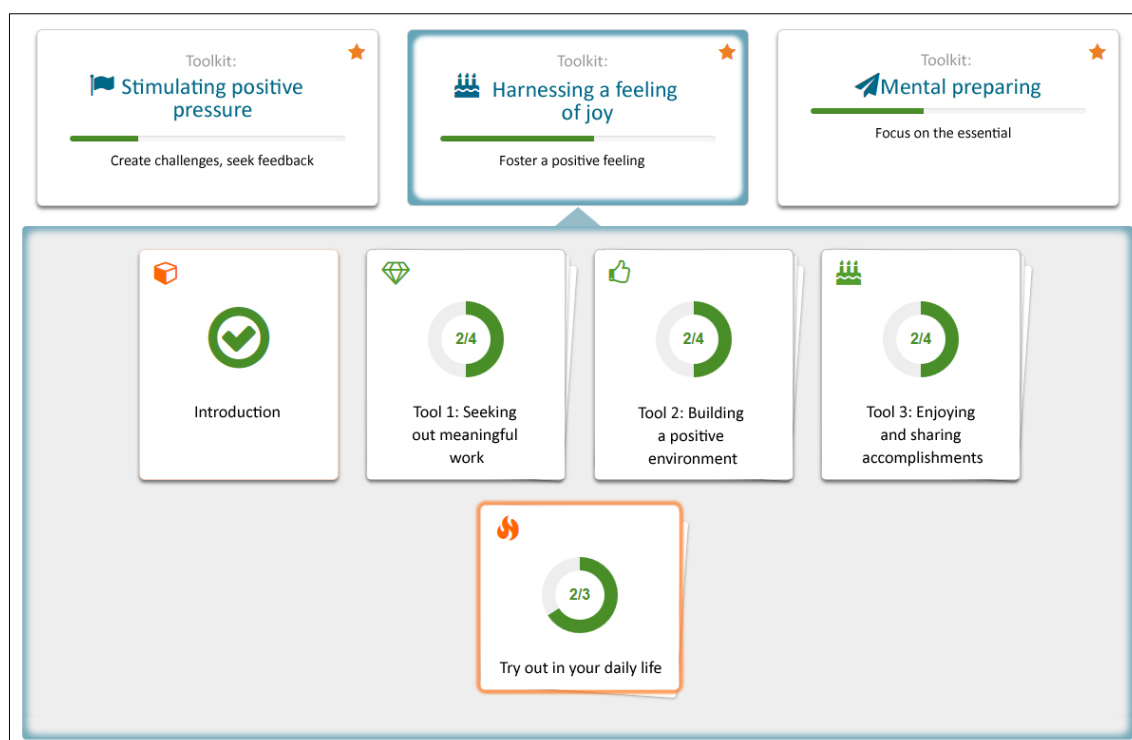


Figure 3. Main view of a toolset: access to introduction, three tools, and off-line exercises.

by round progress indicators, which display the number of steps completed in each tool. The indicators turn into check marks when all steps within a tool are completed.

Eustress Tools

All tools have an identical internal structure and consist of three steps: a description of the tool, entrepreneur quotations, and a reflection exercise. Furthermore, after completing each tool, the users can provide feedback to the researchers. The quotations from entrepreneurs who participated in the first phase of data gathering were used to illustrate real-world experiences related to the tool and to show the origin of the tool (see an example in Figure 4). This way of presenting the tools can make them feel more authentic and interesting, and also enable learning from peers according to design guideline 4.

The reflection exercises aim to help users identify their own practices and habits and to assess how the tools relate to their lives. This is done through one or more questions prompting self-reflection on the topics presented in the tool. A text box is provided for entering notes and reflections.

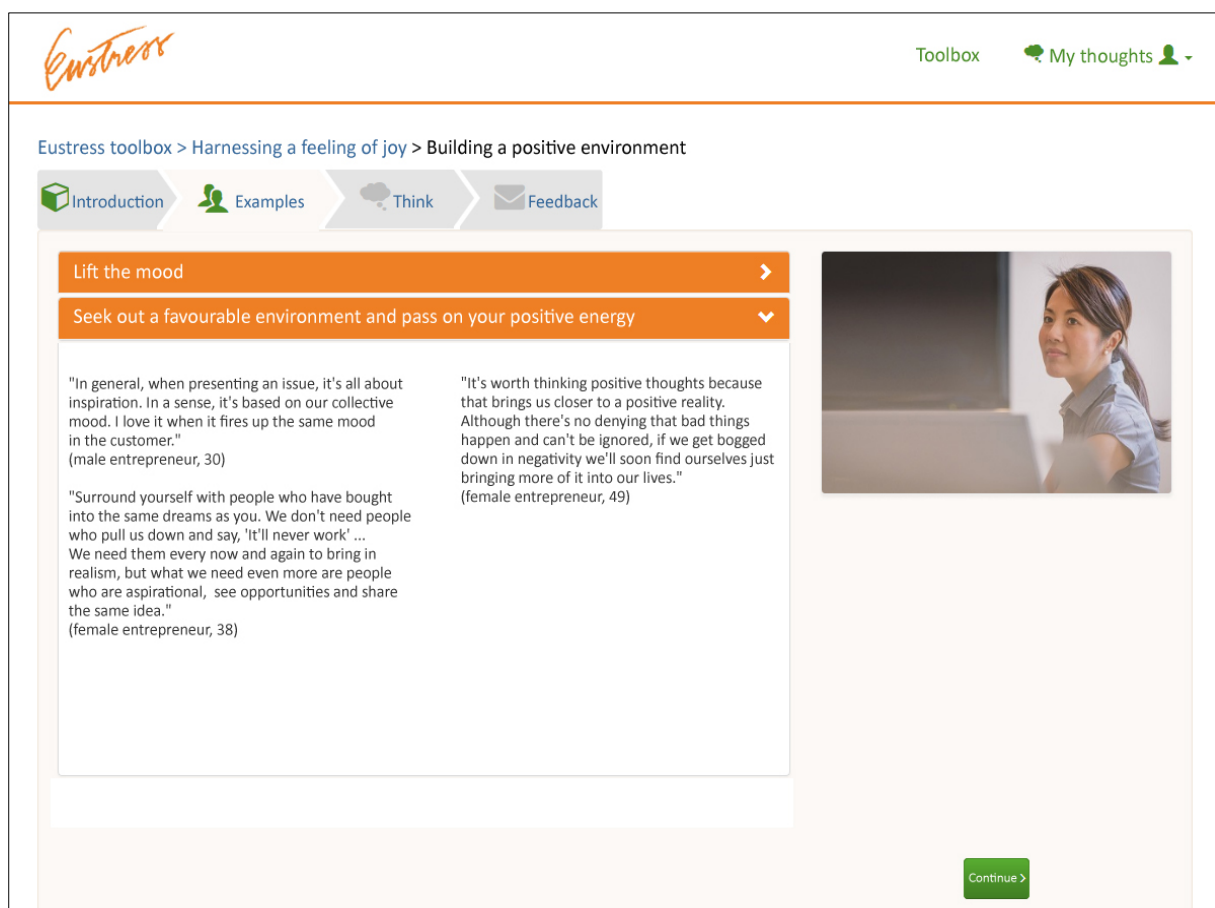


Figure 4. Example of contents of a tool: quotations from entrepreneurs who participated in the first phase of data gathering. Photo by Jeremy Bishop on Unsplash.

An example of a reflection exercise related to recalling successes asks the user to look back on one's successes at work:

When have you felt the feeling of success in a challenging work situation? What did you do?

Can you recall a situation where you succeeded even though you were afraid of failing? What did you learn?

The users can see only their own responses to the reflective exercises. Should they wish to revisit those comments, they can access them via the tools or via the main view (e.g., see the My Thoughts option; upper right of Figure 1).

Off-line Exercises and Eustress Applications

The last step of each toolset is an off-line exercise that aims to provide an opportunity for the users to rehearse the skills and, ultimately, to integrate them into their daily lives. The users are provided with 2 to 3 off-line exercise options and are asked to select one to complete during the following week. Off-line exercises consist of long activities, such as planning work tasks on a weekly basis or including a moment of recovery to each day of the week, and shorter exercises, such as having a meeting with oneself to analyze one's values or envisioning and trying out a new approach to a work assignment. Detailed instructions for completing the exercise are provided and the users may also write down their own plans for the exercise. The commitment and plans are then sent to their email as a reminder. Twenty-four hours after activating the exercise, a reflection form is enabled in the Toolbox, allowing the user to reflect on the exercise during or after the rehearsal period and to mark it as done after completing it.

An example of an exercise related to the toolset of Harnessing a Feeling of Joy challenges the user to lift his/her own mood and that of others:

Praise Week

On each day of the week, praise yourself or someone else for a job well done, an inspirational attitude, or a brave try. This can be about even small deeds and successes and is just one way to surprise others and create a positive buzz around you. Remember to choose yourself as a recipient of praise on at least one of the days!

Answer the following questions after Praise Week: Did you remember to praise someone every day? What kinds of reactions resulted from praising others? Did you learn something during the week or begin to see anything in a new light?

As part of the off-line exercises, users also are provided with links to selected third-party mobile and Web applications related to the toolset. These applications aim to provide practical tools to foster eustress and give users additional means for integrating the skills into their daily lives and work. For example, in the first toolset (i.e., Self-reflection), a mindfulness-related application² is provided, and in the second toolset (Organizing Work), applications for listing, scheduling, and delegating tasks are included.³

Ending Module

The final module of the service contains an ending questionnaire that repeats the questionnaire presented in the introduction module. The ending questionnaire opens only 3 weeks after the first use session to ensure that users have had time to practice the skills before

repeating the questionnaire. After the users complete the questionnaire, graphical feedback summarizing the status of various eustress skills is provided along with a comparison to the screening questionnaire status. This feedback enables the users to reflect on what they have learned during the program and to see their progress in the skills related to the toolsets.

DISCUSSION

This paper sheds light on entrepreneurs' means to feel eustress in their daily lives and, based on this understanding, it presents the design process and implementation of an online service prototype, the Eustress Toolbox, for fostering eustress. We wanted to focus on the positive side of stress because research has been focused more typically on the negative aspects of stress. However, a positive view of stress may offer new tools for well-being (Simmons & Nelson, 2007). Although a positive approach has become a growing research and design approach in HCI (Calvo & Peters, 2014; Desmet & Hassenzahl, 2012; Desmet & al., 2013) and interventions fostering psychological well-being have emerged (Ahtinen et al., 2013; Luthans et al., 2008; Mitchell et al., 2009; Ouweneel et al., 2013), design studies and experiments have not focused on the positive side of stress. Our study provides new insights on this phenomenon, based on the experiences of Finnish entrepreneurs. It also proposes a new way to approach work engagement, that is, acknowledging the holistic nature of stress and potentially offering new tools to see some work stressors in a more positive light.

The ways of thinking and working that entrepreneur participants identified as helping them feel eustress were analyzed and grouped into six toolsets of the Eustress Toolbox: 1) Self-Reflection and Changing the Mind-set, 2) Organizing Work, 3) Stimulating Positive Pressure, 4) Harnessing a Feeling of Joy, 5) Mental Preparation, and 6) Recovery. These toolsets have similarities to methods proposed by Hargrove et al. (2013) to help managers encourage eustress among their employees. Hargrove et al. (2013) suggested that eustress experiences can be fostered by offering meaningful work, encouraging mindfulness in the workplace, and supporting employees in understanding their capacity to meet challenging stressors. According to our interviews with the entrepreneurs, the meaningfulness of the work was seen as a particularly important accelerator for eustress experiences. Thus, the first toolset in the Toolbox relates to self-reflection, providing tools that help users find meaning in their work or recognize the meaningful aspects of their work. Seeking out meaningful work is also a tool in the fourth toolset: Harnessing a Feeling of Joy. Our first and fifth toolsets (Self-Reflection and Mental Preparation) acknowledge the benefit of mindfulness. All toolsets can be seen to contribute to understanding or increasing one's capacity to meet challenging stressors through various means: increasing self-knowledge, enhancing the feeling of control of one's work, exposing oneself to challenges, stimulating positive affect, offering means to prepare for challenges, and reminding of the need to rest and recover before new challenges.

A Web-based service was chosen as the delivery channel of the Eustress Toolbox. Web-based services enable easy access, independent of the user's time and location, as well as self-paced use, an interactive and personalized approach to providing content, and the ability to design means to guide the user through a program. Another benefit is the possibility of reminding users of yet-to-be completed tasks and providing feedback on progress. The guidelines used for designing the Eustress Toolbox were (a) minimizing user effort, (b)

providing freedom to discover, (c) enabling follow-up of progress, (d) enabling learning from peers, and (e) supporting integration of skills into daily life. For this service, we considered learning from peers an especially important component as it may be more enlightening and motivational to hear about experiences from peers than from researchers. In the future, this aspect could be further strengthened by providing ways to communicate with other entrepreneurs, for example, by creating a discussion board or an associated Facebook group. Another crucial part of the service was to provide exercises and third-party applications that would support the integration of skills into the user's daily life. There are thousands of applications and services available related to well-being and work management, but finding and adopting them takes time, a commodity in short supply for most entrepreneurs. Integrating recommendations for services such as these may help to lower the threshold for adopting new practical tools. Reflection exercises were designed to help users identify their own practices and assess what each tool signifies for them, enabling the users to internalize the different concepts and skills related to eustress. The intention of the off-line exercises was to encourage practicing the skills in the real world and to help in integrating them into everyday routines.

Our design approach was in line with human-centered design approaches (ISO, 2010) and was related closely to the person-based approach applied by Yardley et al. (2015). Additionally, the PSD model (Oinas-Kukkonen & Harjumaa, 2009) was consulted to include features that would facilitate adoption and increase engagement with the service. Our design was based on the actual experiences of entrepreneurs rather than a specific psychological therapy, which is a typical base for many digital interventions. Moreover, our approach was empirical and experience-based with the goal to learn from the mind-sets and work practices of entrepreneurs, to find out their ways of fostering eustress, and to share the insights through a digital service. In the recent years, both theory-based digital well-being interventions and design experiments based on the empirical user data have increased, and our work is one attempt to foster a dialogue between these fields.

Despite the vast research on work stress, the complex relation between negative and positive stress is far from clear. Although the two sides of stress have been acknowledged already decades ago, stress usually is considered a negative phenomenon and termed as such, and this can result in challenges in studying the positive side of stress. The terms eustress and positive stress divided opinions also in our data, and some entrepreneurs expressed contradictory feelings about the terms, even though they recognized the phenomenon.

Additionally, the relationship of eustress and work engagement is still somewhat speculative and based on only a few linkages presented in earlier studies. As work engagement can be seen as a more stable state than eustress, it may contribute to a greater likelihood of experiencing eustress. Furthermore, the means to foster eustress may increase the attributes of work engagement—such as vigor, dedication, and absorption (Schaufeli et al., 2002)—especially if they are adopted as everyday tools and practices. However, more empirical research and further elaboration on the conceptual level is needed to bring clarity to the relationship between these two concepts. The relationship could be empirically clarified with quantitative research. For instance, surveying a representative sample of entrepreneurs could indicate whether people who experience higher work engagement also experience eustress more often or more intensively. Another option could be an experiment testing into whether practicing the means to foster eustress as a part of daily life also increases work engagement in

the long run. However, the implementation of such research is not straightforward, particularly because no validated measure of perceived eustress exists.

The Eustress Toolbox was created based on the experiences of Finnish entrepreneurs, and in its current form, it is targeted at entrepreneurs. Because entrepreneurs often have a need for effectiveness, the state of eustress can be seen as especially beneficial to them. Entrepreneurs also need to protect themselves from too long days and too intensive working in the goal of maintaining their well-being and mental resources. Further research is required in evaluating whether the current toolsets and processes are the most effective in assisting entrepreneurs in achieving these goals.

We believe the Eustress Toolbox might be beneficial for other user groups as well. As self-leadership skills are important in contemporary working life, the service may be beneficial for employees needing an entrepreneur-like mindset and skills. However, adopting the service requires voluntary interest from the user. Promoting ways to implement eustress by a supervisor involves ethical issues that need to be considered: The tool cannot be used as a means to increase stressful work among employees, no matter how positive that stress might be. By emphasizing the potential of stress as a positive resource, we do not want to deny the harmful effects of distress or to claim that all stressors could be perceived as positive. Instead, we aim at a more holistic view on stress by presenting the entrepreneurs' current practices to foster the positive side of it and explaining a service prototype that may help entrepreneurs in perceiving some stressors as more positive and by challenging their current ways of thinking and working.

The strengths and limitations of the research and design work relate to the user group studied. Entrepreneurs gave valuable insights on eustress, but naturally, the results cannot be straightforwardly generalized to other occupational groups. In the future, qualitative research on other user groups would provide interesting new knowledge. Also quantitative approaches will be needed to give a wider perspective on the subject and validate the results.

The Eustress Toolbox is a Web-based service prototype built for the purposes of this study and its wider utilization would require further developmental steps. In the next phase of the project, the content and implementation of the Eustress Toolbox will be evaluated among a new group of about 20 entrepreneurs and company employees doing entrepreneur-like work. This pilot will be used to study whether the content and design of the Eustress Toolbox are acceptable and useful to the users, as well as to inform us on further needs for development and design ideas. The potential of the Toolbox will be evaluated based on the user experiences, user acceptance, perceived benefits, and initial impacts on the users' well-being or stress experiences.

In the future, it would be interesting to study the use of Eustress Toolbox also with a larger group of users. It would allow us to study the use of the service in relation to work engagement. Specifically, it would be interesting to learn whether the work engagement of the users affects the use of the service and impacts of the benefits of the Eustress Toolbox or vice versa.

IMPLICATIONS FOR RESEARCH AND APPLICATION

This work contributes to the body of research related to eustress and work engagement in the field of HCI. On the theoretical level, the work enlightens the potential connections between

work engagement and the two sides of stress: eustress and distress. The empirical aspect of this research provides an understanding of the work practices of Finnish entrepreneurs and the ways of working that help entrepreneurs foster eustress in their daily lives. These findings present a basis for understanding the potential practical means of achieving eustress, especially in the context of entrepreneurial work. This knowledge provides a foundation for a nascent understanding of the concept of eustress in the work environment that may be beneficial to future theorizing and refinement of the concept, both within the work world and beyond.

Our research also contributes significantly to the research into the design of solutions to support individuals' development and implementation of eustress in their lives. The Eustress Toolbox, a novel online service, provides insights into eustress and offers users the opportunity to practice skills for stimulating eustress in their daily lives. Thus, our research and this article contribute to the field of HCI through a new perspective and a human-driven design example of how to enhance a positive state of mind and work engagement by means of a novel digital solution. Our Web-based service may help practitioners and other members of the HCI community to design engaging and useful services for well-being.

ENDNOTES

1. The devices employed to measure the physiological components of this study were provided by Firstbeat Technologies Ltd., Jyväskylä, Finland. The researchers were trained by the service provider to interpret the data that were collected during the study, and this process was completed in collaboration with each study participant.
2. Information on the Oiva application, developed by VTT Technical Research Centre of Finland and University of Jyväskylä, and currently owned by Headsted Ltd, can be found at <http://oivamieli.fi/>
3. The Trello application is produced by Fog Creek Software, Inc. and can be accessed at <https://trello.com/home> while the Wunderlist application, created by 6 Wunderkinder GmbH, can be obtained from <https://www.wunderlist.com/home>

REFERENCES

- Ahtinen, A., Mattila, E., Väikkynen, P., Kaipainen, K., Vanhala, T., Ermes, M., Sairanen, E., Myllymäki, T., & Lappalainen, R. (2013). Mobile mental wellness training for stress management: Feasibility and design implications based on a one-month field study. *JMIR Mhealth Uhealth*, 1(2), e11.
- Baron, R. A., Franklin, R. J., & Hmieleski, K. M. (2016). Why entrepreneurs often experience low, not high, levels of stress: The joint effects of selection and psychological capital. *Journal of Management*, 42(3), 742–768.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Calvo, R. A., & Peters, D. (2014). *Positive computing: Technology for wellbeing and human potential*. London, UK: MIT Press.
- Cardon, M. S., & Patel, P. C. (2015). Is stress worth it? Stress-related health and wealth trade-offs for entrepreneurs. *Applied Psychology*, 64(2), 379–420.
- Chandola, T., Brunner, E., & Marmot, M. (2006). Chronic stress at work and the metabolic syndrome: prospective study. *British Medical Journal (BMJ)*, 332, 521–525.

- Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York, NY, USA: Harper Perennial.
- Cunningham, J. A., Gulliver, A., Farrer, L., Bennett, K., & Carron-Arthur, B. (2014). Internet interventions for mental health and addictions: Current findings and future directions. *Current Psychiatry Reports*, 16, 521–525.
- Desmet, P., & Hassenzahl, M. (2012). Towards happiness: Possibility-driven design. In M. Zacarias & J.V. de Oliveira (Eds.), *Human-computer interaction: The agency perspective* (pp. 3–27). Berlin, Germany: Springer.
- Desmet, P., Pohlmeier, A. E., & Forlizzi, J. (2013). Design for subjective well-being [editorial]. *International Journal of Design*, 7(3), 1–3.
- Eysenbach, G. (2005). The law of attrition. *Journal of Medical Internet Research*, 7(1), e11.
- Greenhaus, J. H., & Callanan, G. A. (1994). *Career management*. Ft. Worth, TX, USA: The Dryden Press.
- Hasson, D., Anderborg, U. M., Theorell, T., & Arnetz, B. B. (2005). Psychophysiological effects of a web-based stress management system: A prospective, randomized controlled intervention study of IT and media workers. *BMC Public Health*, 5, 78–91. <http://doi.org/10.1186/1471-2458-5-78>
- Hargrove, M. B., Becker, W. S., & Hargrove, D. F. (2015). The HR eustress model: Creating work challenge through positive stress. *Human Resource Development Review*, 14(3), 279–298.
- Hargrove, M. B., Nelson, D. L., & Cooper, C. (2013). Generating eustress by challenging employees: Helping people savor their work. *Organizational Dynamics*, 42(1), 61–69.
- Harris, J. A., Saltstone, R., & Fraboni, M. (1999). An evaluation on the job stress questionnaire with sample of entrepreneurs. *Journal of Business and Psychology*, 13(3), 447–455.
- Heikkilä, P., Ainasoja, M., & Oksman, V. (2015). The potential of technology in facilitating positive stress experiences. In *Proceedings of the European Conference on Cognitive Ergonomics 2015* (Article 27). New York, NY, USA: ACM.
- Ilies, R., Aw, S. S., & Pluut, H. (2015). Intraindividual models of employee well-being: What have we learned and where do we go from here? *European Journal of Work and Organizational Psychology*, 24(6), 827–838.
- International Organization for Standardization [ISO]. (2010, March). Ergonomics of human–system interaction—Part 210: Human-centred design for interactive systems (ISO Standards No. 9241—210). Geneva, Switzerland: ISO.
- Karasek, R. A., & Theorell, T. (1990). Healthy work: Stress, productivity, and the reconstruction of working life. *The American Journal of Public Health*, 80(5), 1013–1014.
- Kelders, S. M., Kok, R. N., Ossebaard, H. C., & Van Gemert-Pijnen, J. E. W. C. (2012). Persuasive system design does matter: A systematic review of adherence to web-based interventions. *Journal of Medical Internet Research*, 14(6), e152.
- Kivimäki, M., Virtanen, M., Elovainio, M., Kouvonen, A., Väänänen, A., & Vahtera, J. (2006). Work stress in the etiology of coronary heart disease: A meta-analysis. *Scandinavian Journal of Work, Environment & Health*, 32(6), 431–442.
- Langan-Fox, J., & Roth, S. (1995). Achievement motivation and female entrepreneurs. *Journal of Occupational and Organizational Psychology*, 68(3), 209–218.
- Lazarus, R. S. (1966). *Psychological stress and the coping process*. New York, NY, USA: McGraw-Hill.
- Lazarus, R.S., & Folkman, S. (1984). *Stress, appraisal and coping*. New York, NY, USA: Springer.
- Le Fevre, M., Kolt, G. S., & Matheny, J. (2006). Eustress, distress and their interpretation in primary and secondary occupational stress management interventions: Which way first? *Journal of Managerial Psychology*, 21(6), 547–565.
- Luthans, F., Avey, J. B., & Patera, J. L. (2008). Experimental analysis of a web-based training intervention to develop positive psychological capital. *Academy of Management Learning & Education*, 7(2), 209–221.
- Ly, K. H., Asplund, K., & Andersson, G. (2014). Stress management for middle managers via acceptance and commitment-based smartphone application: A randomized controlled trial. *Internet Interventions*, 1(3), 95–101.

- Mitchell, J., Stanimirovic, R., Klein, B., & Vella-Brodrick, D. (2009). A randomised controlled trial of a self-guided internet intervention promoting well-being. *Computers in Human Behavior*, 25(3), 749–760.
- Nelson, D. L., & Cooper, C. (2005). Stress and health: A positive direction. *Stress and Health*, 21(2), 73–75.
- Oinas-Kukkonen, H., & Harjumaa, M. (2009). Persuasive systems design: Key issues, process model, and system features. *Communications of the Associations of Information Systems*, 24(1), 485–500.
- Orsila, R., Luukkaala, T., Manka, M.-L., & Nygård, C. (2011). A new approach to measuring work-related well-being. *International Journal of Occupational Safety and Ergonomics*, 17(4), 341–359.
- Ouweneel, E., Le Blanc, P. M., & Schaufeli, W. B. (2013). Do-it-yourself: An online positive psychology intervention to promote positive emotions, self-efficacy, and engagement at work. *Career Development International*, 18(2), 193–195.
- Portnoy, D. B., Scott-Sheldon, L. A., Johnson, B. T., & Carey, M. P. (2008). Computer-delivered interventions for health promotion and behavioral risk reduction: A meta-analysis of 75 randomized controlled trials, 1988–2007. *Preventive Medicine*, 47(1), 3–16.
- Rahim, A. (1996). Stress, strain, and their moderators: An empirical comparison of entrepreneurs and managers. *Journal of Small Business Management*, 34(1), 46–58.
- Schaufeli, W. B., & Bakker, A. B. (2004). Job demands, job resources, and their relationship with burnout and engagement: A multi-sample study. *Journal of Organizational Behavior*, 25(3), 293–315.
- Schaufeli, W. B., Salanova, M., González-Romá, V., & Bakker, A. B. (2002). The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of Happiness Studies*, 3(1), 71–92.
- Selye, H. (1974). *Stress without distress*. New York, NY, USA: J. B. Lippincott Company.
- Seligman, M. E., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist*, 55(1), 5–14.
- Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *Occupational Health Psychology*, 8(1), 27–41.
- Simmons, B. L., & Nelson, D. L. (2007). Eustress at work: Extending the holistic stress model. In D. L. Nelson & C. Cooper (Eds.), *Positive organizational behaviour* (pp. 40–53). London, UK: Sage.
- Sonnentag, S., & Fritz, C. (2015). Recovery from job stress: The stressor-detachment model as an integrative framework. *Journal of Organizational Behavior*, 36(S1), S72–S103.
- Stratton, E., Lampit, A., Choi, I., Calvo, R. A., Harvey, S. B., & Glozier, N. (2017). Effectiveness of eHealth interventions for reducing mental health conditions in employees: A systematic review and meta-analysis. *PLoS One*, 12(12), e0189904.
- Tikkamäki, K., Heikkilä, P., & Ainasoja, M. (2016). Positive stress and reflective practice among entrepreneurs. *Journal of Entrepreneurship, Management and Innovation*, 12(1), 35–56.
- van Straten, A., Cuijpers, P., & Smits, N. (2008). Effectiveness of a web-based self-help intervention for symptoms of depression, anxiety, and stress: Randomized controlled trial. *Journal of Medical Internet Research*, 10(1), e7.
- Yardley, L., Morrison, L., Bradbury, K., & Muller, I. (2015). The person-based approach to intervention development: Application to digital health-related behavior change interventions. *Journal of Medical Internet Research*, 17(1), e30.

Authors' Note

We thank all the volunteer entrepreneurs who participated in the study and shared their experiences on eustress and their everyday lives. We also thank our colleagues who participated in conducting the data collection, analyzing the results, and building the Eustress Toolbox. In addition, we thank Tekes, the Finnish Funding Agency for Technology and Innovation, for funding our research.

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Human Technology
ISSN 1795-6889
www.humantechnology.jyu.fi

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