# Motivational Design for Computer-Supported Collaborative Ideation

Veronika Gamper

Technische Universität München
Lehrstuhl für Datenverarbeitung

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**Veronika Gamper**

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Institute for Data Processing, Technische Universität München, 80290 München, Germany, http://www.ldv.ei.tum.de.

# Zusammenfassung

In einer zunehmend globalisierten Welt erlangt Innovationsführerschaft für Unternehmen zunehmend an Bedeutung. Unternehmen bauen auf das Wissen und die Kreativität ihrer Mitarbeiter und zunehmend auch auf externen Input ("Open Innovation"), Ideen für neue Produkte, Services und Geschäftsmodelle beizutragen. Dies geschieht heute noch vor allem in persönlichen Meetings, jedoch werden zunehmend auch Ideenplattformen eingesetzt. Diese online Ideenplattformen können dabei helfen, geographische Distanzen zu überbrücken und Abteilungsgrenzen zu überschreiten, sowie Nachteilen traditioneller Brainstorming-Sitzungen entgegenzuwirken. Jedoch werden sie heute noch nicht breit eingesetzt.

Das größte Hindernis in der Akzeptanz von Ideenplattformen liegt in der Motivation der Nutzer sich auf solchen Plattformen zu engagieren. Ein höheres Engagement auf der Plattform führt zu mehr Ideen, was wiederum zu einer höheren Wahrscheinlichkeit führt, dass gute Ideen zur Auswahl stehen und in Folge zu einer höheren Erfolgsquote der ausgewählten Projekte. Dies wiederum erhöht die Akzeptanz seitens des Managements. Daraus ergibt sich die Relevanz der übergreifenden Forschungsfrage, welche im Rahmen dieser Dissertation beantwortet wird: Wie können wir das Engagement von Nutzern in kollaborativen, computergestützten Ideenfindungsprozessen erhöhen?

Um diese Forschungsfrage zu beantworten, betrachtet die erste Analyse den Status Quo von Ideenfindungsprozessen in Unternehmen, welche möglichen Verbesserungen sich durch Softwareunterstützung ergeben können und welche Nachteile diesen entgegenstehen. Gamification stellt einen vielversprechenden Ansatz dar, das Engagement der Nutzer zu steigern. Daher werden daraufhin diverse Aspekte von Performance-Feedback analysiert, welches ein elementarer Bestandteil der meisten Gamificationelemente ist. Schließlich wird die Persönlichkeit von gewünschten Lead Usern untersucht, welche Aufgaben im Ideenfindungsprozess sie gerne verrichten und inwiefern sich dies zwischen offline (in persönlichem Zusammensein) und online Settings unterscheidet.

Zusammenfassend sind es vor allem kollaborative Aufgaben, denen eine hohe Bedeutung beigemessen wird, die jedoch in einem online Setting motiviert werden müssen. Der Schlüssel liegt darin, den heutigen einheitlichen Ansatz von Ideenplattformen zu diversifizieren und auf die Unterschiede unter den gewünschten Nutzern einzugehen: Aufgaben sollten auf Fähigkeiten und Aufgabenmotivation der Nutzer zugeschnitten werden und Feedback sollte so gestaltet sein, dass ihr pos-

itiver Beitrag transparent wird um sie so zu weiterer Zusammenarbeit an Ideen zu motivieren.

Diese Dissertation zeigt die Persönlichkeit und Unterschiede in Aufgabenmotivation von gewünschten Lead Usern auf und gibt Vorschläge zu Gamificationelementen und -mechanismen um die verschiedenen Aufgaben in einem computergestützten, kollaborativen Ideenfindungsprozess zu inzentivieren. Die Ergebnisse untermauern die Bedeutung die Zusammenarbeit an Ideen zu motivieren und Nutzerunterschiede zu adressieren.

# Summary

Within an increasingly globalized world, innovation leadership is of immense importance for companies. Companies rely on the knowledge and creativity of their employees and increasingly also external input ("Open Innovation") for the contribution of ideas for new products, services, and business models. This is currently still mainly happening in in-person meetings, but increasingly ideation platforms are being employed. These online ideation platforms can help to bridge the geographical and departmental separation and can help to overcome some drawbacks of traditional brainstorming sessions. However, they are not widely employed yet.

The major inhibitor for the acceptance of ideation platforms is the user motivation to engage on such platforms. An improvement in engagement on the platform leads to a higher number of ideas, resulting in a higher probability that good ideas can be chosen from and hence a higher success rate for chosen projects. In turn, this increases the acceptance by the management. This underlines the relevance of the overarching research question guiding this dissertation: How can we increase user engagement in collaborative, computer-supported ideation processes?

In order to answer this research question, the first investigation deals with the status quo of ideation processes in companies, the potential improvements through computer-support and current drawbacks that counteract them. Gamification represents a promising approach to increase the engagement of users. Therefore, subsequently, diverse aspects of performance feedback are examined, as this is an elementary part of most gamification elements. Finally, personalities of desired lead users are analyzed, which tasks in an ideation process they like to perform and how this differs between offline (in-person) and online settings.

In sum, it is above all collaborative tasks that are deemed to be highly relevant, but that need to be motivated in an online setting. The key lies in diversifying the currently uniform process employed on ideation platforms and to adjust it to the diversity among the targeted users: Tasks should be customized to the abilities and task motivations of the diverse users and feedback should be designed so as to make the positive impact of their contributions transparent in order to motivate them to collaborate.

This dissertation portrays the personalities and differences in task motivation of desired lead users and gives suggestions on gamification elements and mechanisms that may motivate the different tasks in a computer-supported, collaborative ideation context. The findings underline the importance of enticing collaboration and the relevance of addressing differences among users.

# Acknowledgement

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Oftentimes, the journey of a PhD student is described as an odyssey, with many ups and downs, and I confirm that both successes and failures are an essential part of the journey, as are the many distractions. This thesis would not have been possible without the help of a number of people that I would like to thank.

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# Contents

# 1. Introduction

*"That is how innovation happens: Chance favors the connected mind"*
– Steven Johnson, author of bestseller *Where Good Ideas Come From [64]*

Within an increasingly globalized world and highly dynamic markets, the ability to innovate is crucial for companies in order to stay competitive. However, while innovation is of utmost importance, across industries, 40% of new products fail on the market [19]. This not only amounts to enormous costs of failure, which could be partly avoidable if potential pitfalls on the long path of innovation from idea to market success were addressed and acted upon early on. It also speaks for an early involvement of relevant stakeholders (e.g. suppliers, producers, sales agents, sales channels, customers/consumers) to address and help solve potential issues.

## 1.1. Motivation

In 1942, Schumpeter [107] coined the term 'creative destruction', arguing that due to continuous attacks by competition, organizations need to innovate through the introduction of new products, services or processes in order to keep their market position. Also Porter [96] notes "Companies achieve competitive advantage through acts of innovation." Today, the knowledge economy and increasing competition on a global scale are believed to increase the need for innovation [72]. Faster developments in technology, increasing R&D costs and shortening product life cycles generate a higher need for new product development [40].

While Schumpeter propagated the model of a single innovator [107], more recent innovation models focus on an interactive and collaborative approach to innovation [46, 70, 115]. In fact, various research suggests that the key to successful innovation lies in the collaboration of people with complementary knowledge and diverse skills [38, 101, 93].

Furthermore, with organizations being increasingly active on a global level and building alliances across the globe, virtual team work is gaining importance [84]. Electronic brainstorming thereby becomes a promising alternative to traditional brainstorming held in in-person meetings. This dissertation aims to shed light on computer-supported ideation processes, and on collaborative innovation platforms in particular, focusing on motivation for users to collaborate on ideas.

The overarching research question shall be defined as follows:

> How can we increase user engagement in computer-supported, collaborative ideation processes?

## 1.2. Research Gap and Guiding Research Questions

In a large, multidisciplinary study on definitions of innovation used in science, Bareghegh et al. [8] came up with the following definition of innovation:

> Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.

As pointed out in the previous chapter, innovation is of crucial importance for companies in an increasingly global market and therefore highly competitive environment. With employees and company-external stakeholders being addressed as sources of ideas, companies are increasingly employing innovation platforms to capture their input [22]. Computer-mediated ideation allows to bridge geographical distances and to cross departmental boundaries. Research on electronic brainstorming (EBS) also suggests that it can counteract drawbacks of traditional in-person brainstorming processes, such as evaluation apprehension or the fear of evaluation [18], production blocking (less productivity as people are kept from generating ideas while listening to others) [36] and social loafing (free-riding when groups are too large) [66].

Although research suggests that electronic brainstorming leads to more and better ideas [49, 30] and innovation platforms are increasingly being employed, companies currently are still relying substantially on traditional in-person brainstorming sessions [29]. Dennis and Reinicke [29] suggest that the missing acceptance is rooted in the fact that for users it is not idea quality and idea quantity that is their major goal, but also aspects such as group well being and member support. This led to research question RQ 1:

> RQ 1: From a users' perspective, how do offline and online ideation processes differ?

This research question was divided into the following sub-questions 1.1, 1.2 and 1.3:

> RQ 1.1: What are advantages of offline ideation processes?
>
> RQ 1.2: What are advantages of online ideation processes?
>
> RQ 1.3: What advantages of offline ideation processes are online processes currently lacking?

Expert facilitators of ideation processes in interviews unanimously reported that online ideation platforms mainly lack user engagement. Although initially engagement may be on an acceptable level, it typically declines very fast. Hence, increasing engagement is of utmost importance. A promising approach to increase user engagement is gamification, defined as "the use of game elements in non-game contexts" [32]. It is used to foster user engagement, i.e. to motivate users to interact more with a service or application, by trying to make it more "fun" to use it [33]. A central element of most gamification elements is performance feedback, which led to research question RQ 2:

> RQ 2: How should performance feedback be delivered in an online ideation context?

The delivery of performance feedback can be analysed from various points of view. Within this dissertation, the focus was on analyzing the best timing, content and visibility of performance feedback, as they are all main decision factors when it comes to choosing among a plethora of gamification elements.

While one main component of gamification elements is the provision of feedback to the users about their performance, proving feedback during ideation seemingly contradicts one of the well-known rules of brainstorming: to defer feedback [88]. At the same time, feedback may even improve the creative output: a) it can increase the intrinsic motivation, b) it can influence the mood of a person, c) the expected standard of creative output may be clarified, and d) the recipient can learn skills and strategies relevant to be creative [124]. This leads to the following research question 2.1:

> RQ 2.1: Should feedback occur as soon as possible or be delayed?

Closely related is the question of what elements of performance feedback should be shown, in what form and to whom they should be displayed. From expert interviews it became clear that the very same gamification elements could be motivating to some, while demotivating to others. Furthermore, visibility of feedback needs to be studied carefully. Fear of evaluation has been identified as a major inhibitor in offline ideation processes [18]. This leads to research questions 2.2:

> RQ 2.2: What type of feedback in terms of content and visibility is suitable to engage users?

In order to understand which user needs should be addressed and to be able to give suggestions on concrete gamification elements to be employed or studied in further research, the following research question 2.3 was formulated:

> RQ 2.3: What are promising gamification elements and what user needs are they based on?

It has been shown that gamification techniques can have a different impact on different personality types [17]. According to an extensive literature review on gamification [57], there is a lack of research on the impact of gamification elements based on different user types. As pointed out in the previous paragraphs, the question of motivating participants to collaborate on a platform and retain them warrants further investigation for online ideation platforms to succeed. This dissertation connects task motivation on ideation platforms to personal values, in order to consequently give suggestions for effective motivational design.

This leads to research question RQ 3:

> RQ 3: How can different users be motivated to participate, engage and collaborate on online ideation platforms?

Dahl et al. [25] state that implementing technology for collaborative innovation is less about technology, than it is about designing for human systems. In fact, individuals differ in their personalities [41], and due to these individual differences, user behavior differs from person to person. Hence, applications that aim to appeal to a broad range of people should take these differences into account [83, 95]. The attempt to provide one solution for all may lead to no one being really satisfied [9]. This leads to research question 3.1:

> RQ 3.1: What are desired lead users' personalities like?

Just like personalities differ, also preferences for certain tasks in the creative process differ. Several creativity process models have been defined [120, 4, 12, 91], conceptualizing the tasks involved in creative processes. Füller et al. [48] identified different user types in online innovation communities, pointing out that e.g. the group of users that merely comments is an important user segment by helping to render the online community lively. One particular area of interest is the motivation to collaborate: Research has shown that collaboration of people with diverse background and knowledge is key to successful innovation [38, 101, 93]. As the myth of the lone innovator is being debunked [115], innovation platforms are increasingly striving to be collaborative. Identifying different motivational groups, by classifying users according to their motivation and personalities, is hence of high interest. This leads to research question 3.2:

> RQ 3.2: Which tasks within a creative process do desired lead users like doing?

Closely related is the question whether there is a motivational gap between an offline and an online setting. If for certain tasks there is a higher motivation in an offline setting, this may indicate an improvement potential for these tasks in online ideation settings. If users do like the task by itself, it suggests that the setting impacts their motivation. As gamification elements give performance feedback, enable

communication and foster interaction, thereby mimicking certain offline interactions, they may possibly level out the current drawbacks of online interaction. Thus, the following question 3.3 was formulated:

RQ 3.3: Is there a gap between online and offline task motivation?

Figure 1.1 gives an overview of the research questions.

This dissertation aims to investigate whether gamification elements may increase user engagement on collaborative, online ideation platforms. The studies presented aim to provide insights for both researchers and practitioners in the field of innovation management software and creativity support tools. From the research perspective, the research presented contributes to the literature at the intersection of creativity support tools, computer-supported collaborative work and gamification / motivational design. From the practical perspective, the studies shed light on potential pitfalls when implementing innovation management and creativity support software. They point out areas of improvement and elaborate on design implications.

The next section outlines the structure of this dissertation, listing the studies conducted to answer the aforementioned research questions.

## 1.3. Approach and Structure of the Thesis

### 1.3.1 Overview on the Chosen Approach

To answer the overarching research question on motivational design to motivate users to engage in collaborative online ideation processes, several second-order research questions were investigated (see Figure 1.1).

First, an extensive literature research (section 2) and interviews with experts in the related fields (section 3.1) were conducted. This was followed by empirical user studies (sections 3.2 and 4.1). Both expert interviews and user studies identified several tasks as crucial for successful ideation, while also suggesting that many of these tasks need to be motivated in online settings. Also different approaches to creativity became apparent, entailing the need to study differences among users.

Following the user studies, participants of online ideation processes were interviewed on their preferences with regards to timing, content and visualization as well as the desired level of visibility of performance feedback (section 4.2). With the goal to gain additional qualitative information, two focus groups of five people allowed for insights into different task preferences. A shortlist of promising gamification elements was generated (section 4.3).

Finally, the insights from literature research, expert interviews, user studies, user interviews, and focus groups led to a larger quantitative study (section 5). The goal was to characterize the desired lead users of ideation platforms based on their

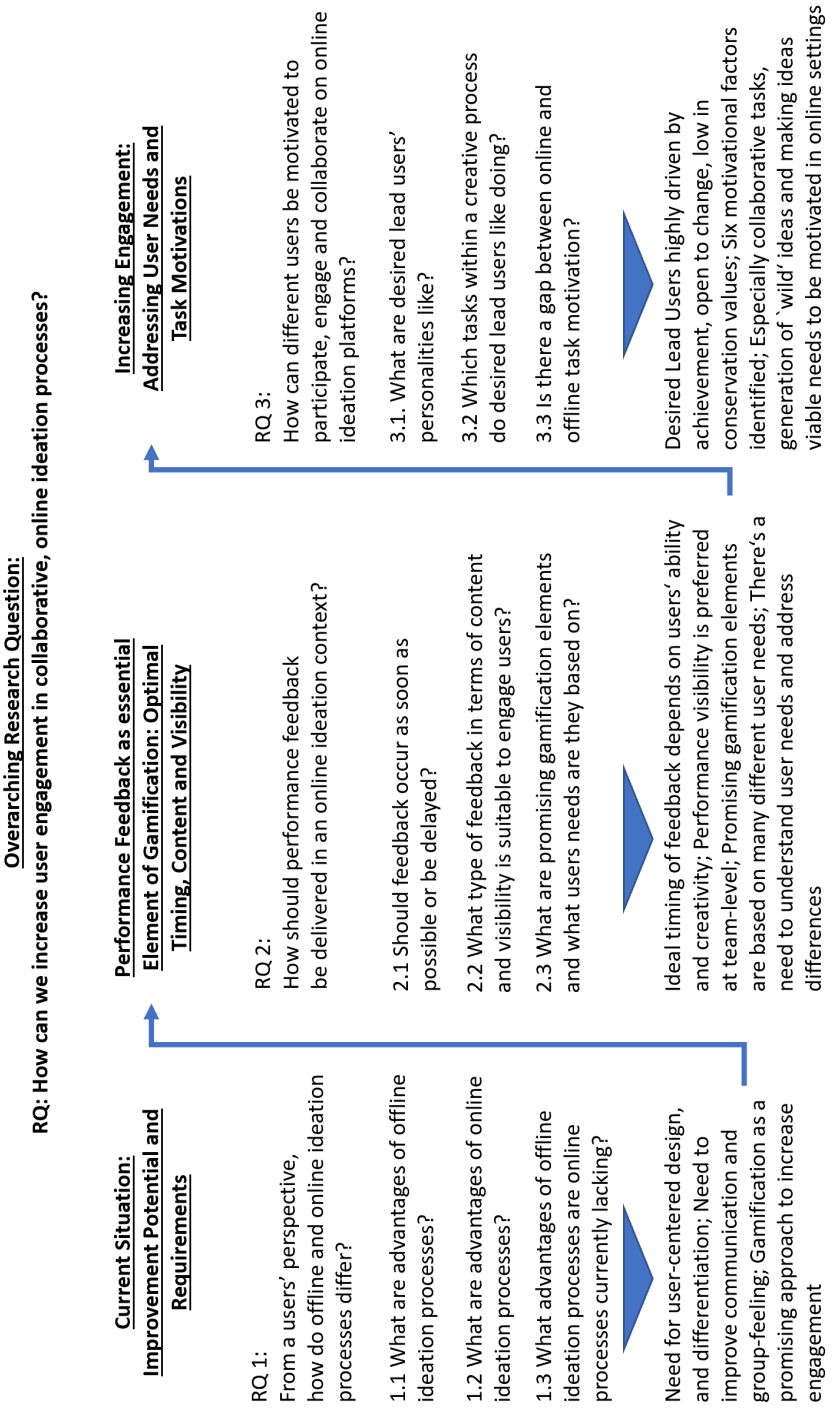


**Figure 1.1.:** Research question adressed in this dissertation

personal values, to quantitatively evaluate their task preferences with regards to offline and online ideation processes and find differences, which subsequently can be addressed.

The next section outlines the methodological approach and references the respective chapters, which build upon each other. Figure 1.2 depicts the structure and summarizes the content elaborated in the respective chapters.

### 1.3.2 Structure and Summary of Results

To give an overview on both relevance of the topic and the status quo of research, I start with a dive into scientific literature on creativity, electronic brainstorming, innovation, creativity support tools, personal values, motivation, and gamification (section 2). It results in a list of drawbacks of traditional, in-person brainstorming identified by prior research, while referring to the possibility to counteract them by computer-support. This, in turn, constitutes the basis for expert and user interviews.

Contemporarily, a top-down overview on the current state-of-the-art of ideation processes and issues in in-person and computer-supported ideation is given: From a managerial, more practical perspective - by interviewing experts in the leading of innovation processes, and experts in motivational design (section 3.1). They describe their approaches to idea generation, which software-solutions they employ and the associated advantages and areas for improvements.

The interviews confirm several findings from literature and give rise to further hypotheses, which form the basis for the subsequent studies of this dissertation. Among these findings are: a) that the creative process differs from person to person, b) that knowledge on a topic ('prepared mind theory') can foster the generation of ideas, c) that fear of evaluation is a major problem for participants to engage in ideation processes, especially with regards to contributing 'wild' or out-of-the-box ideas, d) that there's a need to carefully evaluate content and timing of feedback and the associated choice of gamification elements (e.g. collaborative vs. competitive character of feedback or gamification elements).

The subsequent user study (section 3.2) examines the potential for software-support in collaborative ideation platforms by the example of morphological analysis. Being a rather complex creativity technique, the hypothesis was that a software-supported session might be preferred over a traditional in-person session in groups. From participants' statements on their reasons for preference, advantages and disadvantages of both conditions are derived. Overall, the software-supported process was preferred over the paper-based approach, attributed to a better process support and the fact that software could give team members a more fair share in the team ideation process. However, the paper-based approach was deemed to allow for better communication, useful e.g. for clarifying questions and supporting the building upon the ideas of others.

From the expert interviews (section 3.1) and the user study (section 3.2) several

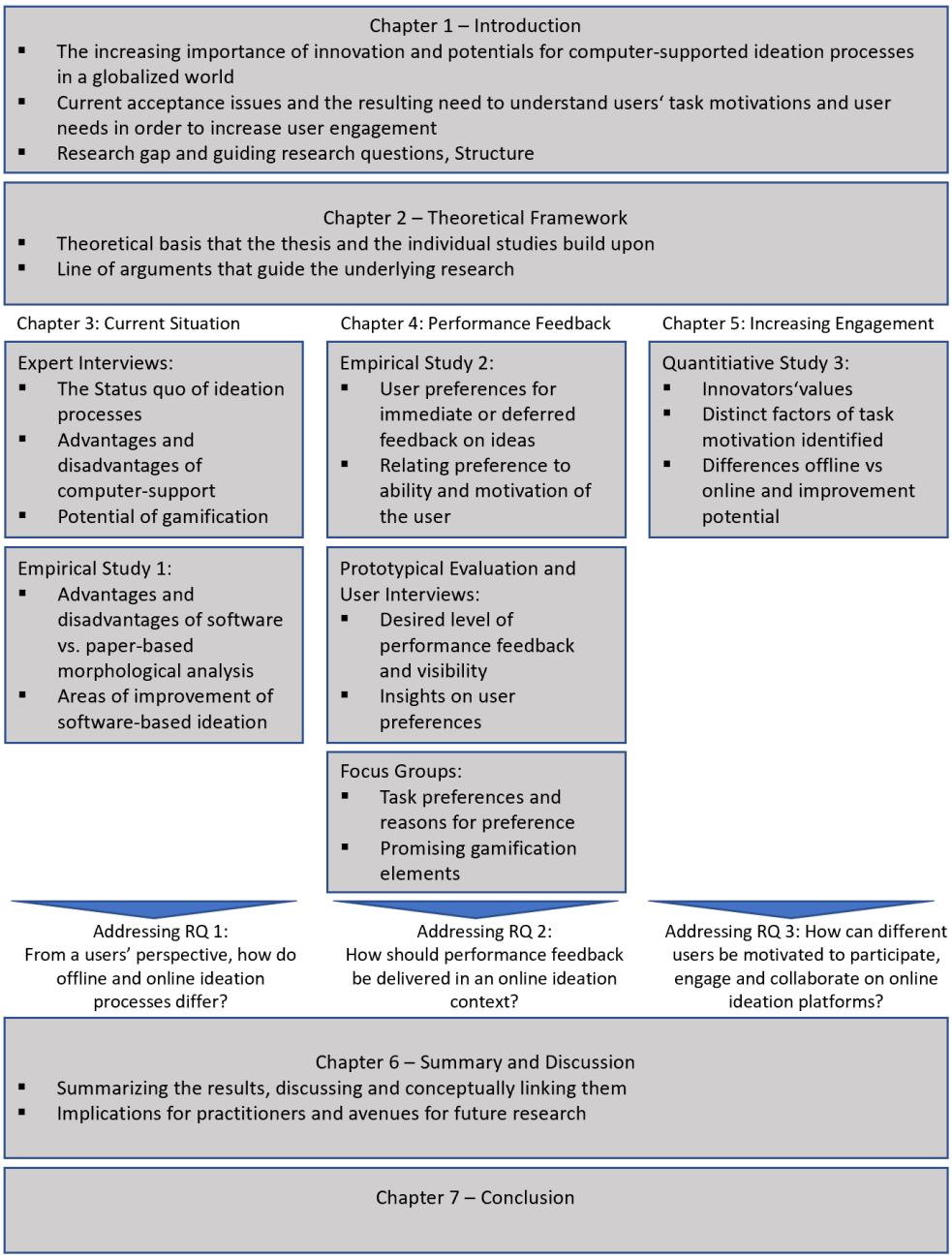


**Figure 1.2.:** Structure of the dissertation by chapter

areas for improvement for computer-supported ideation emerged. As the interviews and study suggest, engagement could be increased, especially if communication, the ease of building upon ideas of others and group well-being were improved. Both literature research and expert interviews support that gamification has the potential to increase engagement.

Performance feedback is a core element of most gamification elements. Section 4.1 examines the time dynamic of performance feedback, which has been subject of discussion. With feedback commonly being discouraged in creative processes (see Osborn [88]), this rule seemingly contradicts a principle common of most gamification elements: providing performance feedback. The mixed-method user study examines the acceptance of an immediate feedback mechanism in a collaborative, computer-supported ideation process.

Preferences were mixed and did not directly correlate with user and/or team performance. The analysis of participants' self-perception of their motivation and ability led to the following proposition: That participants who considered themselves already highly motivated and highly able (with regards to the task) preferred to ideate by themselves and to defer feedback, while others were inspired and / or motivated by reading and evaluating other people's ideas while in the idea generation phase. This points towards the need to differentiate among users, which can impact the choice of gamification elements and the timing of their presentation.

Another highly relevant aspect of performance feedback is the desired *content* and *visibility* of it. In section 4.2, the focus is on the level of detail and visibility of perfomance feedback, by the example of most commonly used gamification elements, such as points, badges and leaderboards. I asked twelve participants who had taken part in an online ideation process to fill a questionnaire on their preference for a certain gamification element representing their performance in various visibility settings - to themselves, to other people of their own team, and to other individuals. The findings are supported by quotes from subsequent user interviews.

In preparation of a larger quantitative study, ten people who had previously taken part in online ideation processes were asked to join one of two focus groups of five people each (section 4.3). After individually ideating on a platform for fifteen minutes, the participants were asked to indicate their preferences for certain tasks. The analysis showed that task preferences were highly diverse among the ten participants. Consequently, the participants were introduced to the gamification user types and gamification elements suggested for each type [35, 78]. They were asked to select any elements they deemed useful for increasing engagement within computer-supported ideation processes. This resulted in a ranked list of the proposed elements. The analysis of the underlying gamification user type for the ranked elements suggests that a mix of diverse gamification user types and hence underlying needs need to be addressed. The different preferences as and different user needs to be addressed led to a quantitative study on personalities and task preferences of desired lead users.

In the concluding quantitative study with 146 participants, the personal values of desired lead users — based on the Theory of Basic Human Values [109] — and their online vs. offline task motivation are analyzed (section 5). An exploratory factor analysis leads to six motivational factors that are then analyzed with regards to differences between offline and online settings. The results suggest large improvement potential especially with regards to collaborative tasks, which show the highest divergence between offline (higher) and online (lower) task motivation.

In sum, the studies in this dissertation suggest the following answers to the overarching research question *How can we increase user engagement in collaborative, online ideation processes?*:

Overall, online ideation processes currently lag behind offline ideation processes, especially with regards to ease of communication (RQ 1). Gamification is seen as potentially increasing user engagement and performance feedback is a major element of it. Timing of performance feedback should ideally be based on the users' perceived own ability and motivation with respect to the task. Furthermore, performance feedback should preferrably be delivered on a team basis and not on an individual basis, especially when it is visible to other people (RQ 2). Desired lead users for online ideation platforms score high with regards to values such as *Openness to Change*, *Self-Enhancement*, *Self-Transcendance*, while they score low on *Conservation* values. For certain task types, they are considerably more motivated in an offline setting than in an online setting. These gaps in motivation may be a promising starting point to address with appropriate motivational design, including gamification. The following tasks types result as promising to address with motivational design: 1) Collaboration tasks, 2) generating 'wild' ideas and 3) making ideas viable, such as detailing out ideas (RQ 3).

To summarize, this dissertation suggests that there is potential to increase engagement in collaborative, computer-supported ideation processes, with the highest pay-off in focussing on three types of tasks: collaborative tasks, tasks related to generating 'wild' ideas and tasks relating to making ideas viable. This should be done by employing a highly user-needs-centric motivational design, accounting for the different motivations and needs of the heterogeneous users. It can be accomplished by selecting motivational design in general and gamification elements in particular that best address the desired lead users' values (as reported in section 5). Timing and level of visibility should be adapted to the users' perceived level of ability and motivation, to their task motivations, and to their needs, while avoiding common pitfalls mentioned by both users and experts.

# 2. Theoretical Background

This chapter introduces the theoretical concepts that form the basis for this dissertation. It both provides an overview of relevant previous research and clarifies the terms used. The focus lies on research with special relevance for gaining an overview on the topic underlying this dissertation. Further literature, relating specifically to the published studies will be referenced directly in the studies.

The first section introduces the topic innovation, referencing various definitions of it and clarifying the definition adhered to within this dissertation. In the second section, the origins of the term "Creativity" and an overview on research in the the field is given, introducing the process model for creativity by Teresa Amabile [4]. Next, Creativity Support Systems (CSS) and their increasing relevance for ideation processes in a globalized world are explained and extant research on benefits and drawbacks of computer-support in an ideation context is referenced. In the following section, the concept of individual differences and the Theory of Basic Human Values, underlying the study on users' personalities, is introduced. Subsequently, previous findings on incentivizing participants on ideation platforms are elaborated.

The overall goal of the dissertation is to study how to increase user engagement on online ideation platforms. Gamification is considered a promising approach. As performance feedback is an integral part of most gamification elements, I include a section on the pros and cons of performance feedback.

Finally, the chapter concludes with an elaboration on the potential benefits of gamification for encouraging a certain user behavior and increasing engagement.

## 2.1. Innovation

Innovation by itself is a broad concept. While many definitions have been given, the term *innovation* has been operationalized in different ways in research. According to Lee et al. [74] it may mean scientific inventions, patents, technological breakthroughs or simply new ways to do things. Furthermore, several aspects have been defined as distinguishing characteristics of innovations: newness, diffusion, commercial exploitation and value creation being the most prominent ones. For example, the notion of newness is central of the definition of innovation by Rogers [102]:

> An innovation is an idea, or object that is perceived as new by an individual or other unit of adoption. It matters little [...] whether or not an idea is objectively new as measured by the lapse of time since its first use or discovery. The perceived newness of the idea for the individual determines his or her reaction to it. If an idea seems new to the individual, it is an innovation.

In the definition by Mueller-Prothmann and Doerr [79], an invention can be called an innovation only if it reaches a certain degree of diffusion in a user group or market. Hence it includes the necessity to reach a certain number of people beyond the individual. Roberts goes a step further with his definition, which involves the notion of usefulness and / or commercial exploitation [100]:

> Innovation is composed of two parts: (1) the generation of an idea or invention, and (2) the conversion of that invention into a business or other useful application.

Roberts made the statement that “Innovation = Invention + Exploitation” [100]. While exploitation is most often associated with commercial diffusion. However, this does not have to be the case. This is also reflected by Roberts’ definition, as also includes non-commercial contexts. An invention may also be exploited in non-commercial applications, while having a strong impact on economy or society.

The notion of commercialization is part of the definition of innovation according to Freeman [47]:

> Inventions do not necessarily lead to technical innovations. In fact the majority do not. An innovation in the economic sense is accomplished only with the first commercial transaction.

According to Lee et al.[74], from the perspective of an organization, innovation is tied to the creation of new value, from either an economic, social or technical perspective.

For this dissertation, I will adhere to the definition of Roberts [100] reported above, which is general enough to both encompass innovation in both commercial and non-commercial contexts.

## 2.2. Creativity

The term *creativity* originates in the Latin word *creare*, which translates into ’create’. For most part of history, creativity or the ability to create something new used to be associated with high intellect and genius [54]. In the 1950’s, interest in the field surged and research on creativity started to take off. In the beginning, research mainly focused on creativity of the individual [55]. Among the first notable research

is the one conducted by the American researcher Joy Paul Guilford [55], who came from a background of research on intelligence and personality. He suggested that creativity could be learned, that it could both be fostered and impeded. Further research followed, with Osborn [88] defining brainstorming as a creativity technique and establishing rules for effective brainstorming sessions, which were also applied to divergent thinking in general [90]. Torrence in 1966 [117] developed the so-called 'Torrence Test of Creative Thinking' (TTCT), a test measuring the ability to think creatively in response to the existing tests on analytical thinking skills, thus strenghtening the awareness for this field of research. Significant contributions to the field were made by Harvard researcher Teresa Amabile, amongst others on creativity in teams (together with Terrri R. Kurtzberg [69]) and on organizational settings [3], pointing out relevant factors that impact creative performance.

Over the history of research on creativity, many different definitions for creativity have been given [89]. The *4 P's of Creativity* model by Rhodes [98] outlines different perspectives that exist with regards to creativity, which explains the different definitions. According to Rhodes, the different perspectives on creativity are:

1. Person: Who is creative?
2. Product: What is creative?
3. Process: What is the creative process?
4. Press: What is the creative environment?

For the purpose of this dissertation, the following definition by Amabile [3] will be adhered to:

> Creativity is the production of novel and useful ideas by an individual or small group of individuals working together

#### A Process Model for Creativity

Over time, several process models for creativity have been defined [120, 4, 12, 91]. This dissertation will refer to the process model by Teresa Amabile [4]. She names five phases of the creative process:

1. **Problem or Task Identification**: The stimulus to start the process
2. **Preparation**: The gathering of information necessary to address the problem or task
3. **Response Generation**: Thinking of potential answers, e.g. by re-combining and connecting known information

4. **Response Validation and Communication**: Evaluating the answers from the previous phase on their aptitude to solve the problem or task, based on factual knowledge or other criteria

5. **Outcome**: The final evaluation of the result. The process ends if the results are satisfactory. If it is not satisfactory, another iteration starts.

## 2.3. Creativity Support Systems (CSS) and Online Ideation

In this dissertation, the focus lies on the unstructured, fuzzy front end or 'creative' part of the innovation process — the phase preceding the product development process, which is far more structured. A main element of this fuzzy front end part of the process, is the idea-generation phase, which in this dissertation I also refer to as *ideation*. In my definition, the general term *ideation* involves the various steps of the creative process as just defined in the previous section 2.2 on the model for the creative process, from *Problem or Task Identification* to deciding on the *Outcome*.

Information and Communication Technology solutions have gained increasing popularity in supporting the innovation process, both for the brainstorming or idea generation (*ideation*) part of the process [30, 28], as well as for the following idea management part [44] in the form of idea management software.

In literature, the online support of the fuzzy front-end part of ideation is mostly elaborated on in studies on 'electronic brainstorming' (e.g. [23, 31, 29, 28]).

I adhere to Forster [45] for the definition of *creativity support systems (CSS)*:

> Creativity Support Systems (CSS) are information systems which support creative processes.

In this dissertation, I use the terms 'creativity support systems' (or CSS), 'computer-supported ideation' and 'online ideation' interchangeably.

While electronic brainstorming can lead to more and better ideas than traditional verbal brainstorming, it can also counteract some major disadvantages of traditional brainstorming [31]: Fear of evaluation [18], production blocking [36] (e.g. people being 'blocked' from working when others talk or present) as well as free-riding (i.e. people not participating, especially when groups are too large) [66].

However, electronic brainstorming is still lacking acceptance according to Dennis and Reinicke [29]. They argue that the missing acceptance of creativity support systems can be explained by users less valueing quality and quantity of ideas, but rather putting value on group well-being and member support.

In a workshop with renowned researchers of the U.S. National Science Foundation twelve principles for the design of creativity support tools were defined [112].

These were:

1. Support exploration
2. Low threshold, high ceiling, and wide walls [1]
3. Support many paths and many styles
4. Support collaboration
5. Support open interchange
6. Make it as simple as possible — and maybe even simpler
7. Choose black boxes carefully
8. Invent things that you would want to use yourself
9. Balance user suggestions with observation and participatory processes
10. Iterate, iterate — then iterate again
11. Design for designers
12. Evaluate your tools

Many of these principles are supported by studies in this dissertation, and additional principles are added, studying users' preferences, personal values, task motivations and differences among users, which leads to the next section.

## 2.4. Personality Differences

Individuals differ in their personality [41] and because of these individual differences, user behavior differs from one person to another. Applications that are intended for use by a broad range of people, should consequently adress these differences [83, 95]. The attempt to find one solution for everyone may lead to no one being truly satisfied [9].

Schwartz' Theory of Basic Human Values [108, 110, 109] is an established approach in research to explain the differences among individuals based on their different values. The theory has been validated in a large number of studies and across different cultures [26, 109]. Opposed to the 'Big Five' (Openness, Extraversion, Neuroticism, Conscientiousness, and Agreeableness) [24], which also explains different behavior of individuals, personal values are less stable. They are defined as

[1] Annotation by the author: in the sense of allowing an easy onboarding to novices, high ceilings for allowing experts to work on challenging projects and wide walls to offer many opportunities for exploration

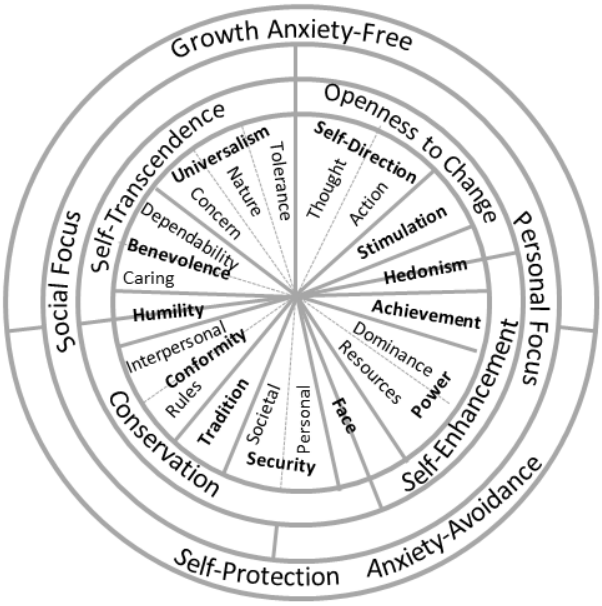


**Figure 2.1.:** The proposed motivational continuum of 19 values proposed by Schwartz' et al. [109], figure adapted from the same source

a number of convictions or life principles, which are shaped by the environment and change over time [108, 86]. Figure 5.3 depicts the 19 values and the corresponding higher-order values as defined by Schwartz [109].

## 2.5. Incentivizing Participation on Ideation Platforms

Ideation platforms are striving to be increasingly collaborative. Studies have shown that participants benefit from being exposed to the ideas of others and that the myth of the 'lone inventor' is outdated [115]. Recent studies have in fact found that a mix between competition and collaboration is beneficial to the performance of ideation platforms, both company-internal [14, 42] and company-external with consumers [16, 62]. The studies measured the participants' activity in posting own ideas as competitive behavior and commenting on others' ideas as collaborative behavior.

According a model by Leimeister, Huber, Bretschneider and Krcmar [75], the number of ideas and the number of comments on ideas of others by participants can be activated with motives and incentives. To improve participation on ideation platforms, it has been suggested to on the one hand facilitate interaction, knowledge sharing and feedback, which improves the community feeling [1, 75], and on the other hand to design incentives and reward structures to motivate peo-

ple [1, 42, 105]. Next to access to experts and appreciation by peers [75], gamification elements have been proposed to increase participation [126].

Previous studies showed that some game elements, such as points, were able to improve certain actions and their output on online ideation platforms, while others, such as avatars or storylines, were not [105]. On the platform 'Stackoverflow' used for posing and answering questions (hence related, although not an ideation platform), virtual awards could steer user behavior towards a desired outcome [5].

Baumann and Stieglitz [13] found that non-monetary rewards were more effective than monetary incentives, and low-powered incentives were found to increase cooperative behavior and coordination in companies [60]. As Werbach and Hunter [122] point out, external rewards like points and badges may decrease intrinsic motivation if they are not carefully thought through. Especially in a workplace setting, extrinsic and intrinsic motivation are not independent [76, 67, 27], hence to find the right balance is of high relevance.

As previously pointed out, the motivation of individuals differs due to their different personalities [41], and also with regards to the specific task that should be carried out [61]. Therefore, incentivizing the different tasks in the ideation process requires both a deep dive into the personalities of users, into their task preferences and into the aptitude of various motivational and / or gamification elements.

## 2.6. Performance Feedback and Exposure to Sample Ideas

The topic of feedback is of particular interest, as it forms the basis for most gamification elements. Performance and activity are being conveyed to the user by the means of points, badges, leaderboards and other elements from games, and are often put in relation to the performance and activity of other users.

Research studies have shown that the picture of the lone innovator is more and more being replaced [115]. The exposure to sample ideas can inspire people to come up with their own ideas [58, 39, 73]. The timing of when a person is exposed to ideas of others can influence the person's performance, hence it should be thoroughly analyzed [114].

Ideation platforms usually follow the rules of traditional brainstorming (based on in-person meeting of participants). Brainstorming is a well-known, widely applied creativity technique, which was introduced by Osborn [88] in 1953. The rules, as defined by Osborn, are as follows:

1. Critique is not admitted
2. 'Free-wheeling' is welcome
3. Quantity is sought
4. Combination and improvement are sought

The rule of no criticism or to defer criticism has been subject to dicussion. Studies have found that participants that expect external evaluation were less creative [2], other studies found that in a setting with the instruction to discuss and criticize ideas was even outperforming a setting with the instruction not to criticize [80]. With regards to feedback in general, Zhou [124] examined feedback in organizational settings and found feedback to even promote creativity: a) feedback can increase the intrinsic motivation of people b) feedback can influence a person's mood c) feedback can clarify the standards of the expected creative output and d) it can help the person receveing the feedback to acquire creativity-relevant skills.

The main reason to postpone feedback is to counteract fear of evaluation [18]. Studies however have found that even non-anonymous electronic brainstorming can lead to more ideas and less fear of evaluation than face-to-face brainstorming [23]. Hence, one could hypothesize that feedback in computer-supported ideation processes may have less of a negative connotation than in face-to-face brainstorming.

Regarding the exposure to sample ideas, studies found both positive and negative effects, with the timing of exposure playing an important role [82, 81, 114]. It has been suggested that early exposure to sample ideas may increase the level of creativity of the ideas [68]. According to the SIAM (Search for Ideas in Associative Memory) theory, positive and negative effects can occur depending on the timing of the exposure to sample ideas [82, 81]. On the one hand, participants may be inspired [58, 73, 39], on the other hand, participants may experience 'functional fixedness' or 'fixation' by reading sample ideas of others, without them even being aware of it [92]. Other studies suggest that the best timing for showing sample ideas is when participants run out of ideas [114]. Expert facilitation by providing guided inspiration from incoming ideas — another potential source of feedback — was found to lead to more creative and a higher number of ideas [20, 21].

## 2.7. Gamification, Different User Types and their Needs

The most well-known scholarly definition of the term *gamification* is by Sebastian Deterding [33]:

> 'the use of game design elements in non-game contexts'

The goal is to both improve user experience and user engagement on certain non-game activities [34]. In a broader sense, it is associated with 'Behaviour Change', as the goal is to induce people to start an activity, to do it more or less intensely or to quit doing an activity.

Research on gamification is rooted in research on motivation, especially on intrinsic motivation. As Edward Deci and Richard Ryan [103] put it, intrinsic motivation is defined as 'doing something because it is inherently interesting or enjoyable' as opposed to extrinsic motivation, defined as 'doing something because it leads to a sep-

arable outcome'. In their Self-determination-Theory Deci and Ryan name three core intrinsic motivators, namely *Competence*, *Autonomy* and *Social relatedness* [104].

Findings by Daniel Pink, author of *Drive: The surprising truth about what motivates us* [94], are highly similar. The book deals with intrinsic motivation from a management perspective, with the three core drives *Mastery*, *Autonomy* and *Purpose* [94]. These three core drives are highly similar to the ones identified by Deci und Ryan, except for *Social relatedness* from the self determination theory by Deci and Ryan [104] being replaced by *Purpose* in Daniel Pink's drives.

Other research on games and gamification revolves around the identification of certain motivational types. Based on workshops with experts, Richard Bartle defined a player taxonomy [10]. He defines four types of player types, namely *Achievers*, *Explorers*, *Socializers*, and *Killers*. As he later pointed out and as was empirically validated by Yee [123], the underlying motivations do not exclude each other, but may co-exist. Bartle [11] also defines a certain user path which the different user types typically follow, by which the users transition from the typical behavior of one user type to the one of another user type several times in the course of their journey.

The work by Bartle was later taken up and extended by Andrzej Marczewski [78] for the area of gamification. In his work, Marczewski establishes a relationship between the player types by Bartle [10] and the aforementioned theories of motivation: The Self-determination-Theory [104] and the Drive Theory [94], which — as just described — largely overlap. Marczewski builds upon the four player types by Bartle for his gamification player types and adds two more, identified in empirical projects and expert workshops.

In his definition of the six gamification user types, Andrzej Marczewski [78] references the theories introduced above and names six core motivations for the six gamification user types: *Autonomy*, *Mastery*, *Purpose*, *Social relatedness*, *Change* and *Rewards*. Thereby he refers to the four intrinsic motivators from the Self Determination Theory and the Drive theory (*Autonomy*, *Mastery*, *Social relatedness*, *Purpose*) and adds the extrinsic motivator of *Rewards* as well as the need for *Change*. Four of the six gamification user types are built on the aforementioned intrinsic motivators: The *Philanthropist*, the *Achiever*, the *Free Spirit* and the *Socializer*. The *Player* type is based on the need for *Reward*, the *Disruptor* type is based on the need for *Change*. The following paragraph reports the original definition of the gamification user types as given by Marczewski [78]:

> "**The Philanthropist:** Motivated by Purpose. This group are altruistic, wanting to give back to the other people and enrich the lives of others in some way.
> **The Achiever:** Motivated by Mastery. They are looking to learn new things and improve themselves. They want challenges to overcome.
> **The Free Spirit:** Motivated by Autonomy. Some are looking to be creators, other explorers. Try to cater for both if you can. All like to be free!

**The Socializer:** Motivated by Relatedness. They want to interact with others and create social connections.
**The Player:** Motivated by Rewards. Will play your “game”, to gain rewards. Players are a subset of users containing Networkers, Exploiters, Consumers and Self Seekers.
**The Disruptor:** Motivated by Change, Disruptors come in four types. They can be of great assistance, but can cause a lot of trouble as well."

Marczewski [78] also gives suggestions on suitable gamification elements for certain gamification user types, which his findings support to address the needs of a certain gamification user type particularly well. In his work with Diamond et al. [35], the following elements are suggested to address the needs of the six gamification user types:

**Socializers:** guilds/teams, social networks, social comparisons, and competitions
**Free Spirits:** explorative tasks, nonlinear gameplay, Easter eggs, unlockable/rare content, creativity tools and customization
**Achievers:** challenges, certificates, learning, quests, levels/progression and boss battles
**Philanthropists:** collection and trading, gifting or the possibility to share knowledge
**Players:** Points/Experience Points, physical rewards/prizes, leaderboard/ladders, badges, virtual economies or lotteries/games of chance
**Disruptors:** innovation platforms, voting mechanisms, development tools, anonymity and anarchic gameplay

By identifying the underlying users’ needs and the most suitable gamification elements, one can better address the users in the intent to increase their engagement.

# 3. Current Situation: Improvement Potential and Requirements

This chapter describes the findings from expert interviews and user studies that allowed to understand the Status Quo of ideation processes in companies, to understand how offline and online ideation differs and what are considered to be the most relevant advantages and disadvantages of computer-support.

The expert interviews build the basis for the subsequent user studies. The approach for these interviews and the most important results are reported in section 3.1. The interviews led to an empirical study on a structured ideation process in an offline and an online ideation setting, reported in section 3.2. It analyzes participants preferences with regards to the two settings and studies the motivations behind these preferences.

## 3.1. Insights from Expert Interviews

Based on initial findings from literature research, expert interviews shed further insights on requirements for computer-supported ideation processes. To this end, ten experts from industry and research backgrounds were interviewed. The experts included first of all people who had conducted offline (in-person) ideation sessions, e.g. innovation consultants and innovation responsibles in their respective organizations. This allowed to identify current shortcomings of in-person ideation-processes, to raise potentials for improvement through computer-support, and to collect the objections against it. Furthermore, it allowed to identify the tasks and actions within an ideation process that would need to be motivated. Secondly, experts on game development and gamification were interviewed, as they could shed light on the potential of game elements and game-like elements for increasing motivation. Themselves being part of the ideation process on games or gamification elements, they could also give insight into the perspective of a participant of the creative process. Finally, since interviews pointed towards collaboration being a key element in successful ideation processes, I interviewed experts on team collaboration in offline and online settings.

A semi-structured interview guide was prepared for the expert interviews. This guide was adapted and extended in the course of the various interviews according to the grounded theory principle [52]. Thus, a framework was given, while at the

same time the interview partners could influence the direction of the interview. The guideline followed a base structure:

1. Input: Introduction of the topic and background on the interview
2. Clarifications to get a better understanding of how the interview partners defined the topic
3. Potential barriers within creative processes (offline and online)
4. Potential motivational approaches to increase user motivation (offline and online)
5. Differences by personality, user group or setting
6. Specific requirements for computer-support in ideation processes
7. Relevant literature and references to experts

Most of the interviews were conducted in person, a few by telephone, all were recorded and then transcribed. The first interviews with leaders of idea-finding processes focused on the creative process, obstacles identified within the process and potential solutions, supplemented by questions on whether and to what extent computer-supported ideation could eliminate these obstacles. Subsequent interviews with gamification experts focused on motivational approaches to overcome previously identified barriers. Finally, interviews with experts on team collaboration in in-person and online settings were conducted to shed light on different personalities and team roles as well as common issues in offline and online collaboration settings.

The following experts were interviewed:

E01: Researcher on Human-Computer Interaction, with a focus on creativity on the internet

E02: Senior Game Designer at game development company

E03: Product Lead at game development company

E04: Associate Professor at a US university, focussing on team structures and interactions in computer-mediated environments

E05: Lecturer for Entrepreneurship and Innovation at a US university, Entrepreneur

E06: Gamification Expert, Consultant, Speaker and Author

E07: Gamification Expert, Consultant, Speaker

E08: Previous Product Lead, now Co-Founder at game development company

E09: Product Lead at game development company

E10: Behavior Change and Gamification Expert, Lecturer, Speaker and Consultant

The expert views were later supplemented by interviews with users of computer-supported idea-finding processes. They were introduced to selected, prototypical gamification elements with potential for motivating engagement in software-supported, collaborative ideation processes. This resulted in further insights into preferences for certain gamification elements and the underlying reasons and thought processes.

#### Interview Analysis

The interviews with experts served to understand the situation today in online and offline ideation, and the main barriers to the acceptance of creativity support systems, in order to verify requirements for creativity support software and to identify possible solutions. In the following section, I list the main findings from the interviews as well as insightful excerpts[1].

The initial focus of the interviews was on software requirements for supporting individual creativity, but the focus soon shifted to supporting collaboration, as interviews and studies showed that the key to success lies in the collaboration of diverse users.

Interviews with product leads of a game development company about creativity in game development showed that the approach to idea development can be very different. This meets the demand to support different approaches and styles by Shneiderman et al. [112]. Interviews with gamification experts underlined the importance of getting to the bottom of user needs, especially with regards to motivating less popular tasks.

The following pages list excerpts from the interviews that had an impact on the further studies and their guiding research questions, as they helped gain a top-down view on the current issues and potential solutions, and consequently helped shape the setup of the subsequent studies.

#### The approach to idea generation differs from person to person

One of the main findings of the interviews is that the way people approach the creative process differs greatly from person to person. The following exemplary quotes highlight this by reporting the approaches of an expert, who likes working in a two-person team and constantly feedbacking rather inspirational ideas, while another expert preferred working alone and basing his ideas very much on data:

[1] Note: Omissions of parts of the spoken text / parts of a sentence in these and any following excerpts from interviews are marked with three dots ("...")

> "to set up an idea ... I particularly like to have at least one extra person doing that together with me. It think that there is a lot of value in having someone else to get this back and forth of ideas, or even some sort of check that you're not going completely over board with some idea that makes sense in your head, but it maybe is not for everybody" [E02]

> "On the ideation side, it was just me ... I try to be data driven ... which games have had staying power, what bits of those are fun ... My approach was very much about volume." [E03]

**Clear objectives are important**
Several interview partners highlighted the importance of clearly defining a goal.

> "constrain the goal ... not the outcome" [E01]

> [game developer:] "we actually also created constraints and goals that the game had to attain for us" [E02]

In brainstorming, lack of time is an issue, as the quotes on the prepared mind and on ideas needing time suggest.

**Ideas preferrably happen to a prepared mind**
The *Prepared Mind* theory was mentioned by an interview partner from academic research, focusing on research on creativity. She underlined the importance that with regards to more complex topics, participants should reflect on the topic or problem statement before brainstorming.

> "Prepared mind kind of thing ... if you try to brainstorm about something complex without having thought through it yourself, like it's a little bit more difficult... they [annotation by the author: the ideas] start out very shallow if you haven't thought about possible connections or, like, similar things or contrasting things." [E01]

> "I believe that boundaries lead to better creativity. So I try to set boundaries for myself there" [E03]

**Ideas need time**
Interviewees mentioned that ideas need time to grow. This is also related to the topic of fear of evaluation and of the early 'killing' of ideas:

> [Annotation by the author: compared to the typical process / procedure in a game development studio] "there was a period of, like, two or three months, where I didn't really have a manager. ... I don't know if our

> concept would have made it to now if we had gone through that process because you kind of have to please everyone. ... the people who are in charge of making those type of decisions are often busy ... or maybe just have fundamentally different views" [E03]

Two factors largely inhibit people from voicing an idea or putting it on a platform: Fear of evaluation and the fear of ideas being 'stolen'.

**Fear of evaluation is an issue**
Fear of evaluation and the early rejection of ideas was considered a major problem in today's idea generation processes.

> "people shooting down ideas" [E01]

> "To actually put yourself out there, ... you have to be a certain type of person." [E06]

> "My initial feeling would be I don't want people to see my work, I don't want them to be able to criticize it." [E06]

> "... the cultural norm is to shut down silly ideas or ideas we perceive as silly. So it's a very tough thing to encourage wild ideas because people are afraid they will be made fun of." [E06]

**People fear the theft of their ideas**
Several interviewees mentioned that recognition for ideas is of enormous importance. Especially in large, hierarchically structured companies, they see the danger that participants do not want to disclose their ideas because they are afraid of lack of recognition and the stealing of ideas or the assignment of ideas to different departments.

> "one fear is always credit... people fear that they won't get credit, or their idea will be stolen." [E05]

> "one that's related to many, many others are competing incentives in an organization. ... if you're in a low-level position ... you're a power-disadvantaged individual who could be sharing an idea that could be taken away ... and you might receive no major credit for that." [E04]

> "organizations kind of want to simplify things, have things fit into certain divisions or product groups. ... "why should I share if other people could take advantage of this?"" [E04]

**Collaboration is key, gamification may support it**
While interview partners see collaboration as key to successful ideation, it seemingly contradicts the competitive aspect of today's ideation processes. A major issue is the ownership people place on ideas. Gamification may be helpful to give new meaning to collaborative tasks and to get rid of the ownership thought with regards to ideas, which inhibits collaboration.

> "And one of the challenges they also faced ... if you have all these ideas, how do you get collaboration amongst competition? ... one of the things that I think can help within gamification or within design is, one, helping people understand what things mean. ... helping them contextualize it, helping them explain it ... trying to find ways to deattach value from the ideas or deattach ownership." [E10]

> "For a small organization or a small business like a start-up, collaboration is a natural by-product of the size of the company. ... as the company grows, you lose some of these natural collaborative advantages." [E05]

**The motivation to collaborate is different from person to person**
Motivation for collaborative tasks varies greatly from person to person. It is hence important to recognize and address the differences.

> "there are people who are more trusting of other people. There are people who are introverted and [people who are] more extroverted. ... there are people who take more caution when working with others." [E04]

> "people who just come in from the get-go are more outgoing... they tend to be less introverts ... they are more willing to socially interact with others." [E04]

> [Annotation by the author: In own research] "we're trying to understand, how they correlated with certain behavioral characteristics over time... people who become collaborators after they participate over time" [E04]

> "Women are much more willing to collaborate without much knowledge than men. ... the human being changes the longer it is in an area and the older it gets. ... You can see a change towards collaboration the older people get... and the safer they feel" [E07]

**Software and workarounds are being employed**
Today, whiteboard tools and tools for various ideation subtasks are employed. People also build their own tools, which suggests that there is a need that can be addressed.

> "not in terms of digital tools... there's tons and tons of white-board tools that we use" [E08]

> "Excel or in Google I set up a document where anybody can write down all the different names that they come up with. They can vote on names. They can comment on names. ... They can write feedback... And then we have an area where there's a random combination of those pieces." [E08]

**A digital tool needs to provide added value**

A digital tool would be used if an added value is perceived and if it was adaptable to one's own needs.

> [On willingness to use a digital tool for ideation:] "If it gives me something that a white board tool would not? With whiteboard tools and with Google Docs, I can already customize it to my exact needs." [E08]

This added value is seen in

a) facilitating collaboration of teams (especially if geographically distributed),

b) facilitating the archiveability and measureability of ideas, and

c) faciliating the categorization and evaluation of ideas.

The following interview excerpts support this.

**a) Digital tools facilitate collaboration in teams, especially when geographically distributed**

> "it motivates people when they realize we can do more together than individually... we are social mammals. ... in collaboration you manage to meet more needs of people as if you were promoting them alone" [E07]

> "... when you're not sitting in the same physical space, using a digital tool like that allows you to track progress of stuff... sharing of a digital file was easier" [E03]

**b) Digital tools facilitate the archiveability and measurability of ideas**

> "when you're working alone... I don't see the need for it. But if you're trying to ideate with a group of people then perhaps the value is greater there. ... communication, record keeping. ... it's a written record, and if you search for it, you can find it with the attached document, as opposed to just if you and I had a conversation over coffee and then we both forget about it later." [E03]

> "the archiveability, the measurability. ... communicate with others in real time." [E07]

**c) Digital tools allow for easier categorisation and evaluation of ideas**

> "usually generating ideas isn't the problem. ... The question is really which ideas do we go with? ... Remember ... at [company name], we're all co-located. We all sit next to each other." [E08]

> "categorize stuff into boxes" [E01]

> "even if we don't have a process for creation, we have some process for evaluation" [E02]

> "... structural tools that help the ideation phase but also help the idea evaluation phase." [E05]

> ".... people will volunteer their time ... in return for just getting some feedback on ... This is why we're doing this ... I think feedback is definitely important in getting people to help on a preexisting idea" [E10]

**Some basic Requirements regarding Creativity Support Software**
Interviewees mention several requirements regarding the design of creativity support software:

**a) Simplicity is key**

> "this is very important. ... you come in, a free form, click send. ... I built myself a page where I enter my ideas... pre-installed in my mobile phone... a form with a headline and a text. And then I can, so to speak, if I somehow wait for the train, and I can think of anything, I can just enter it directly" [E09]

> [note by the author: about using an online tool for visual collaboration] "I don't think I would use it really again. ... it was way too bureaucratic for something that presents itself as open as possible... I wanted it to be a little bit more open in terms of what I can draw, what kind of arrows can I pull? And that was very lacking in this" [E02]

> "a mobile app that's just really simple to use." [E06]

> "I think, whatever solution that is provided needs to do a few things very well and needs to be able to measure and validate success." [E05]

**b) Creativity Support Software has to be social, allow collaboration**

> "definitely have the capability to be social in some way. ... access kind of the same workspace or something like that" [E01]

**c) Feedback is elementary**

> "If feedback is missing, people often feel that recognition is missing at the same time" [E07]

> "... be recognized for it. Recognition is really important here" [E06]

> "helping people feel like their contribution has value and what has value is because, a lot of times, people are good at a specific thing." [E10]

**d) Explaining users the purpose of their actions is very important**

> "Epic meaning and calling ... I refer to it as purpose ... that's really important. ... at an early stage, explain to somebody why their feedback matters." [E06]

**Gamification is seen as a potential solution to increase engagement, but needs to be crafted carefully**

> "The role of gamification is to increase engagement. It's pure and simple. ... trying to push people past barriers that they've put up." [E06]

> "Depending on how you do it, you can actually destroy the creativity. ... putting kind of the extrinsic stuff you often attach to gamification onto a creative process can reduce the creativity quite dramatically." [E06]

> "I've seen it used in innovation platforms ... to see who's active" [E06]

> "it's the creativity part of it you're left to do your own thing, but you still need people to vote for things. We still need people to be active and kind of encourage them to do stuff. ... we need you to comment on things." [E06]

> "and sometimes, if you're looking at workshops, you see them playing games and things just to try and break through the barrier of I'm really fixed in my mindset. ... It's lowering the kind of - your sort of inhibitions." [E06]

> "If you do it wrong an you overdo the extrinsic motivations and they crowd out the intrinsic motivations, that's destructive." [E04]

> "Just merely throwing points on a screen doesn't in itself mean anything... [Note by the author: On gamification:] to be successful it needs to look beyond the simplistic stuff that has — in my view — persisted for far too long." [E04]

> "The hardest thing is gonna be to dissuade the people, the companies, to give out premiums for it... With its classic management thinking, competition, rankings, it destroys the entire system" [E07]

> "Your reward, it's got to be relevant to whatever has happened" [E06]

**Competition has two sides to it**

Competition can be motivating for some, while it is demotivating for others:

> "if we just throw up some kind of leaderboard and some kind of points, ... that can be motivating for some people. But for a lot of people, that isn't motivating. It's actually demotivating, because ... they don't like to be competitive. ... The more we know about people's own dispositions, the more we could better align the kind of gaming mechanics and incentive structures ... to encourage different types of people to do similar type of behavior" [E04]

**Feedback on idea 'quality' may need to be deferred**

> "the final judgment as to whether to kill it or not — I generally defer those until I had enough data to be able to make a good decision" [E03]

> "At the end of the level, you get all the things. ... it doesn't have to be that instant for a lot of them. ... So with innovation, with creativity, there's no need to say instantly "yes, that's brilliant" / "no, that's rubbish" [E06]

**(Social) recognition overall is promising to drive motivation**

> "I think social approval is one thing that is fairly consistent in its power ... receiving acknowledgment from others that they appreciate it." [E04]

> "knowing that someone of higher status in the group acknowledged your post" [E04]

> "if they can get certain credits that are publicly known and acknowledged that they know" [E04]

### Summary of Findings

The expert interviews led to the insight that the approach to the own creative process can highly differ from person to person. Some people prefer to work in teams, while others work alone, some really need feedback from others, while some base their decisions mainly on data. To offer a solution that addresses these differences, it is important to first of all understand the personality and task motivation of potential users and to identify differences among them, thereby making them addressable.

Digital tools are already being employed for certain parts of the ideation process and collaboration tools are being tweaked to adapt to the use case of ideation and idea evaluation. However, the interview partners were not employing yet and / or not satisfied with the current offerings of digital creativity-support tools. At the same time, the use of workarounds points towards a need for digital support.

Advantages of digital creativity support tools were mainly seen as facilitating team collaboration, archiveability, and the evaluation of ideas. Interview partners stated some requirements in order for digital tools to be adopted in the ideation process: First of all, they need to provide a clear value-add, such as the advantages pointed out in this section. Furthermore, they need to be simple to use and should ideally be customizeable to the own needs.

Gamification is seen as having the potential to increase user engagement, however requiring special attention, as the same element can have a very different impact on different people and when applied for different tasks.

## 3.2. Study 1: User Needs in Software-Based Morphological Analysis

With increasingly globally active companies, computer-supported ideation is promising, as it allows geographically distributed experts and employees to contribute with their knowledge and creativity. Especially for more complex ideation processes involving several steps, computer support can provide support in process management. We conducted a user study to investigate the potential of computer support and its drawbacks with regards to a more complex ideation method, the morphological analysis as described by Zwicky [127]. The "Morphological Box" (for an example see Table 3.1) served as concrete presentation of the solution space.

| **Material** | wood | glass | metal | |
|---|---|---|---|---|
| **Function** | eating | writing | crafting | |
| **Number of legs** | 1 | 2 | 3 | 4 |
| **Form of table surface** | round | square | rectangle | oval |

**Table 3.1.:** Example of a morphological box for a table with one combination marked as a potential solution

We conducted an experiment with 23 students. They generated ideas in a team in two conditions: a paper-based session and a software-based session with a software prototype developed as part of a master thesis by LMU alumnus in Media Informatics Stefan Langer. The participants' preferences and reasons for preference as reported in a questionnaire were consequently analyzed and summarized to result in software requirements. Also, the advantages and disadvantages of software-supported ideation were compared to non-software-supported, paper-based ideation. This resulted in a conference publication [51], appended to this section.

Overall, the results showed that preference was considerably stronger for the software-based variant: 13 participants preferred to ideate with the software-based morphological analysis, while four preferred the in-person, paper-based setting. Six participants were indifferent. Participants were more productive (based on the number of ideas) in the software-based setting, while quality (based on ratings on originality and feasibility of ideas) was higher in the paper-based setting. Subsequently, the reasons for the preferences were analyzed and summarised into main topics.

In sum, the results suggest that in a more complex creativity method such as morphological analysis, computer support can provide significant added value over the traditional paper-based approach. The advantages mentioned by the participants were above all performance-related: Higher productivity and better process support. The benefits of computer support in ideation processes were seen in better process support, higher efficiency and the incentivation of wilder (more unusual) ideas. As

computer-support allows to parallelize the actions of the users, participants mentioned benefits in reducing production blocking. Some also mentioned it reduces fear of evaluation. On the other side, the advantages of the paper-based session over the computer-based session that participants mentioned referred mainly to non-performance related aspects. This corresponds to the findings of Dennis and Reinecke [29] that participants are less concerned with the results than with supporting individual persons and the well-being of the group. The fact that these soft factors are more important to participants than the actual output was already postulated by Diehl and Stroebe [37]. In fact, in the study, advantages of paper-based morphological analysis were found especially with regards to “soft” factors that support users, namely better communication and group well-being.

Thus, in order to match the current advantages of paper-based ideation processes, computer supported collaborative ideation needs to allow for better communication between participants, e.g. allowing to clarify questions, and to support the group well-being. Social components (e.g. social gamification elements) might be promising (and are studied in sections 4.2 and 4.3).

The following pages contain the conference publication that resulted from the study.

# A Study on the Acceptance of Computer-Supported Morphological Analysis

Veronika Gamper
Technische Universität Munich
gamper@cdtm.de

Marin Zec
Technische Universität Munich
marin.zec@tum.de

Stefan Langer
University of Munich (LMU)
stefan.langer@cdtm.de

Andreas Butz
University of Munich (LMU)
butz@ifi.lmu.de

## Abstract

*Ideation and innovation can be supported by more or less formalized creativity methods such as brainstorming or morphological analysis. While previous studies have shown increased productivity with computer-supported versions of such methods, their paper-based variants still largely prevail because of non-performance-related factors.*

*We conducted a study with 23 well-motivated and creative participants ideating on hypothetical business ideas using morphological analysis and found that – in contrast to other studies – software support was largely preferred over paper. This might partly be attributed to the more rigid structure of this method, but also to specific benefits of the software such as anonymity. The results of our study raise interesting questions for further investigation.*

## 1. Introduction

Being part of increasingly competitive and cost-sensitive markets, more and more organizations realize the strategic importance of innovation to sustain themselves and achieve a competitive advantage. As a result, these organizations aim to leverage the skills, experience and creative potential of their employees using various processes, tools and techniques such as innovation management and ideation workshops across all organizational levels.

Morphological analysis (MA) is a structured approach to ideation and problem solving typically conducted in teamwork. It was pioneered by Fritz Zwicky in the 1960's and consists of five steps [10]:

1. Formulate the issue at hand as concise as possible
2. Decompose the problem into subproblems and generate partial solutions to the subproblems
3. Create the so-called Morphological Box (MB), which is a compact representation of your formal solution space
4. Start evaluating all configurations contained in the MB (check whether they serve your purpose)
5. Select optimally suitable solutions and apply them

MA is particularly suitable for problems whose solution candidates can be represented as concrete configurations sharing a common abstract form as for example in system or product design. The MB is a matrix representation of the formal solution space of the MA.

Figure 1 shows an example of MA in the product design of a table. A product idea is generated by selecting a configuration within the MB.

| | | | | |
|---|---|---|---|---|
| **Material** | Wood | Glass | Metal | |
| **Function** | Eating | Writing | Handcraft | |
| **No. of legs** | 1 | 2 | 4 | |
| **Form of table surface** | round | square | rectangle | oval |

**Figure 1. Example of a morphological box for a table with one combination marked as a potential solution**

Advances of classical MA and software-support have been proposed and developed (e.g. Ritchey in [9]). However, advice literature remains to refer to the classical MA approach of Zwicky and typically does not reference MA software. Key reasons for this might be higher (perceived) complexity of advanced MA process models and/or little technology acceptance of currently available MA software implementations.

This paper is based on Zwicky's original formulation of MA. The key idea of MA is to (1) identify and define the major decision parameters of the problem, to then (2) assign a range of possible decisions (*values*) to each of the parameters, and finally (3) to generate potential solutions by

investigating possible relationships (configurations) of the decision or design space.

Another well-known creativity technique is brainstorming which was introduced by Osborn in the 1950's [8]. In a classic brainstorming session, group members are expected to be in the same room and freely speak out their thoughts and ideas while following the four rules suggested by Osborn: (1) focus on quantity, (2) no criticism, (3) all, even wild and unusual ideas are welcome, and (4) combine and improve on ideas.

A large body of empirical research found major process losses in verbal brainstorming such as production blocking [4, 5], evaluation apprehension [1] or social loafing [7]. Variations of the brainstorming concept have been proposed to address these issues such as nominal group brainstorming and electronic brainstorming [3].

Despite evidence showing that nominal group and electronic brainstorming tend to yield more ideas than verbal brainstorming, the latter is more widely used in practice. Dennis and Reinicke suggest that the acceptance of electronic brainstorming is low because users are not only concerned with the quantity and quality of the output (performance-related criteria) but consider other factors (i.e. group well-being and member support) to be important as well [2]. Based on theoretical arguments and a survey of 131 part-time MBA students, they conclude that verbal brainstorming contributes more to group well-being and member support than nominal group or electronic brainstorming.

In this paper, we investigate the acceptance of computer support for collaborative ideation using MA. While brainstorming is a loosely structured creativity technique, MA imposes more structure on the ideation process and group interaction. We believe that the perceived usefulness of software support is higher for structured, artifact-oriented creativity techniques such as MA than for less structured techniques such as brainstorming. Thus, we expect that the former should be more readily accepted by users than the latter. While Dennis et al. [2] indicate that verbal brainstorming is preferred over electronic brainstorming, the hypothesis investigated in this paper is that users prefer software for more structured, artefact-oriented creativity techniques such as MA over a pen-and-paper variant. In order to investigate this hypothesis, we developed a MA software prototype and conducted a qualitative study to identify major factors for the acceptance of software-supported MA. We compare a software- with a paper-based creativity session in a field experiment.

## 2. Method

We developed a software for computer-supported MA and conducted a field experiment with 23 students. The students were asked to generate ideas for innovative products and evaluate their group's ideas in either of two settings: (1) using MA software and (2) using a paper-based MA approach. Afterwards participants were asked to fill in an online questionnaire about their experience with each setting.

Finally they were asked to perform a personality test to assess the participants' personality traits.

### 2.1. Participants

The 23 students that participated in the experiment are all enrolled in the same class of a sideline study program on technology and management and come from various study backgrounds, mainly business studies, computer science and electrical engineering. The class is composed of 24 students but one was missing on the day of the experiment.

All participants were enrolled in a seven week course with an expected full-time commitment to the course work and lectures. The students got to know each other in a three-day kickoff meeting shortly before the beginning of the course. The study was conducted at the end of week four. By this point, students had been working together in two different team allocations of 4-6 members during these four weeks.

**Table 1. Participants' demographics**

| Factor | No. | Percentage |
|---|---|---|
| Gender | | |
| *Male* | 18 | 78.3 |
| *Female* | 5 | 21.7 |
| Age | | |
| *20-21* | 3 | 13.0 |
| *22-23* | 8 | 34.8 |
| *24-25* | 7 | 30.4 |
| *26-27* | 3 | 13.0 |
| *28-29* | 2 | 8.7 |
| Study Background | | |
| *Business Studies* | 6 | 26.1 |
| *Computer Science* | 8 | 34.8 |
| *Electrical Engineering* | 5 | 21.7 |
| *Mechanical Engineering* | 1 | 4.3 |
| *Communication Science* | 1 | 4.3 |
| *Consumer Affairs* | 2 | 8.7 |

**Table 2. Participants' scores on the Big-Five personality test (scores between 10 and 50)**

| Factor | Mean | SD |
|---|---|---|
| Extraversion | 35.1 | 5.5 |
| Agreeableness | 37.0 | 6.3 |
| Conscientiousness | 33.4 | 6.6 |
| Emotional Stability | 31.0 | 2.6 |
| Intellect / Imagination | 38.5 | 2.3 |

It was part of the course assignments to come up with new business and product ideas in the field of education. Hence, students were motivated to generate ideas within the experiment since these ideas would also contribute to their curricular project work.

The students were already assigned into four teams as part of the second phase of the course they attended. Three teams consisted of 6 members (teams 1, 2 and 4), one team consisted of 5 (team 3). Each team was made up of students with a business studies background, students with a technical studies background as well as students with a background other than business and technology.

## 2.2. The Software System

We designed a web-based, real-time group ideation system which supports collaborative MA in small groups (preferably less than 6-7 per group). It allows virtual collaboration for distributed teams as well as collaboration on the spot.

## 2.3. Experimental Setup

The experiment was conducted in two rooms of similar size, one reserved for the paper-based ideation session, one for the software-based ideation session.

One of the authors gave an introduction at the beginning of the experiment. First, the concept of the MB as a creativity method was introduced and followed by an explanation of the procedure for evaluating the generated ideas. Then, the first task and schedule of the experiment were presented to the participants, the second task was introduced at the beginning of the second session.

The goal of both tasks was to come up with product ideas in the field of education.

The first task description was: "*Imagine you are part of a company producing blackboards, serving 10% of the annual German market. The goal of your ideation session is: To come up with new, 'fancy' product ideas starting from your current product.*"

The second task was: "*Imagine you are part of a company producing school benches, serving 10% of the annual German market. The goal of your ideation session is: To come up with new, 'fancy' product ideas starting from your current product.*"

The schedule was given as follows. The same time constraints were imposed on each part of each session:

1. **Create the morphological box** (20 min)
   Participants collaboratively defined the parameters of the problem and listed potential values.
2. **Generating ideas** (20 min)
   Participants selected configurations of values from the shared morphological box and added one idea per configuration.
3. **Rating ideas** (20 min)
   Participants rated ideas on a scale from 1 to 7 with respect to two factors: originality and feasibility (which is related to the problem statement). These two factors were the axes of the results matrix.

The students were asked not to talk about the experiment until the end of the two sessions.

Following the introduction to the experiment, two teams (teams 1 and 2) stayed in the room to conduct the software-based ideation session while the two remaining teams (teams 3 and 4) were guided to the other room where they conducted the paper-based session on the same task. Afterwards, teams switched rooms and approaches, respectively, for the second task, which was disclosed right at the beginning of that second session.

In the software-based ideation session, the students were asked to log in with their user id, which allowed them to stay anonymous within the group they were currently working in. Students were not allowed to talk in the software-based setting. As a result, participants were anonymous in contrast to the paper-based setting during which participants were allowed to discuss throughout the session.

In the software session, participants constructed the morphological box by real-time collaboration. In the idea generation phase, they individually selected a configuration from the morphological box, entered a name for each idea and provided a textual description. In the rating phase, they were shown all ideas of their team's members except their own. By clicking on a specific idea item, they were able to read its description. They rated the idea by assigning

two scores for originality and feasibility. Their rating was displayed in a results matrix.

In the paper-based version, participants jointly created the morphological box on a poster. In the idea generation phase, they drew lines on the poster which represented the combination of values they chose for an idea. Then, they wrote down their idea on a sticky note. In the rating phase, they were provided with the results matrix printed on a poster (axes originality and feasibility, ratings from 1 to 7; equivalent to the software variant). On that matrix, they placed the sticky notes of the ideas according to their rating.

The experiment concluded with a questionnaire segment during which participants were not allowed to talk to each other. The questionnaire contained questions on the users' perception and satisfaction with using the software or participating in the paper-based ideation sessions and on their satisfaction with the results from both sessions. The online questionnaire contained questions with ratings on a Likert-scale from 1-7 and text fields for remarks and explanations. Questions on the arguments for their preference on the first page and a number of subsequent questions were intentionally posed as open questions in order to gather input for hypotheses that could then be tested by posing more specific questions in subsequent larger, quantitative studies.

One week after the field experiment, students were asked to anonymously take part in a personality assessment test [6]. Personality assessment results were mapped to the associated experiment survey data by pseudonymous user IDs without disclosing personal information.

We evaluated the performance based on the number of generated ideas and the ratings of the ideas given by the team members within the session. Finally, we looked at the remarks of the students on why they preferred one or the other method or why they might have been indifferent. The remarks were coded independently by two authors on overarching motives. Differences in ratings were discussed to find a common agreement.

## 3. Results

A major result of the study is that software-based MA was preferred over the paper-based version. 13 out of the 23 participants preferred the software version, whereas only 4 participants preferred the paper-based version. The remaining participants were neutral.

**Table 3. Participants' preferences for software vs. paper-based MA**

| Preference | Number of participants | Percentage |
|---|---|---|
| Software | 13 | 56.5 |
| Pen & Paper | 4 | 17.4 |
| No preference | 6 | 26.1 |
| **Total** | **23** | **100** |

Analyzing the arguments, we found that most arguments in favor of the software version referred to factors influencing the task performance on the ideation session. In fact, all participants who preferred the software solution or were neutral, provided one or more arguments regarding task performance. While arguments listed by those in favor of the software mainly focused on performance-related benefits, participants that preferred the paper-based version did not state any performance-related arguments as reasons for their preference. Neutral participants focused both on performance–related and non-performance related factors, mentioning benefits for both the software-based and the paper-based version.

Five out of six neutral participants and all four supporters of the paper-based variant provided non-performance-related arguments, but only with regards to the paper-based version.

In the following, we will summarize the main lines of argument provided by participants. First, we will focus on performance-related arguments. Then, we will discuss non-performance-related arguments. While arguments on task performance were only mentioned to support the software version, non-performance-related arguments were brought up for and against both variants.

The primary line of argument in favor of the software version was mainly based on task-performance-related aspects. The participants were mainly referring to higher efficiency, better process support and better quality of the output.

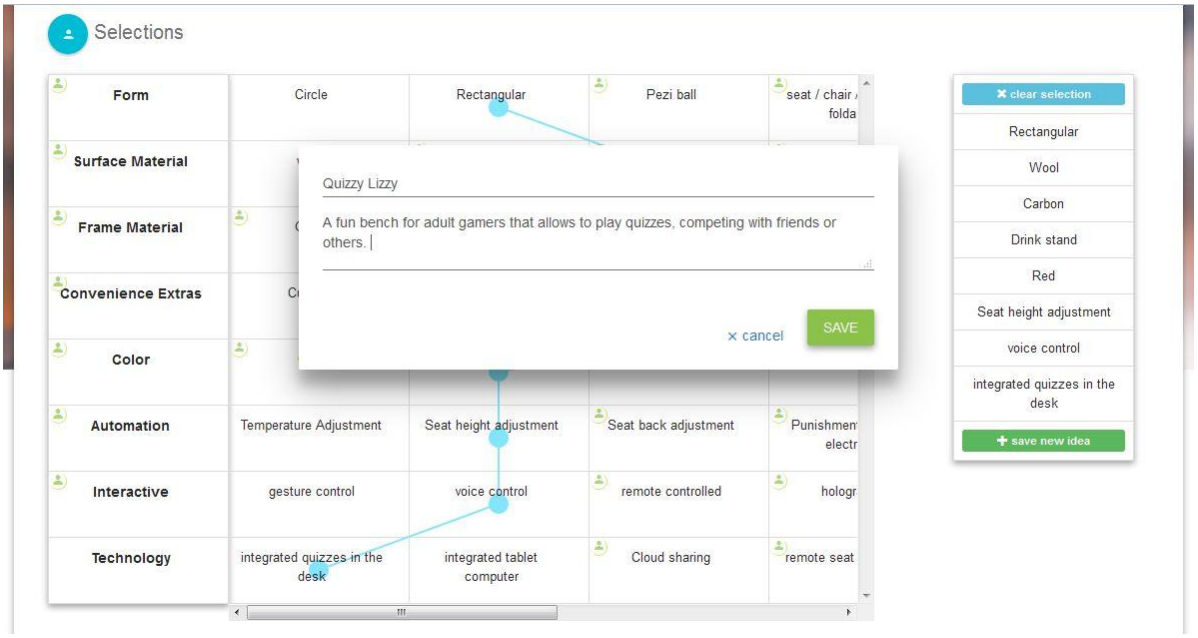


**Figure 2. Generating ideas in software based on collaboratively constructed morphological box**

The higher efficiency of the software was attributed mainly to the parallelization of the process across all phases (morphological box creation, idea generation and idea evaluation) and the missing discussion ("*no discussion, which allowed for clear decisions regarding the validity of each idea [...] This was more efficient*", "*everybody could work at the same time*", "*It was easier to simultaneously collect attributes and ideas*", "*easier to parallelize*", "*no time lost for arguing*", "*more efficient, whereas if you communicate together, you really use up all the time*" or more general comments "*A lot faster*", "*people can write without any problem*").

Process support was perceived to be higher in the software setting and primarily justified with the visual representation features of the software throughout all process steps (arguments mentioned among others were "*better overview*", "*more structured*", "*less chaotic*", "*less clutter*", "*cleaner*", "*no limitation in row and column entries*", "*rating the ideas in 4 quadrants was done much better in the software*"). In contrast, the paper-based version was considered rather chaotic ("*The paper-based version got very messy and chaotic*", "*the other 'paths' were more distracting*", "*too many lines on paper in paper-based version*", "*when trying to define the lines, it was just a huge mess of lines, attributes and properties.*").

Two participants claimed that the use of the software led to more creative output, which they explained with the software encouraging participants to enter wilder, unusual ideas ("*potentially crazier ideas*", "*Although some idea seemed unreasonable at first (which in a paper-based version would've been scratched out), on the platform they led to pretty radical ideas which was voted on by most people.*").

Non-performance-related criteria were also highly relevant to participants, some supporting the software, some the paper-based variant.

Although participants who were in favor of the software version mainly mentioned performance-related criteria (all 13 mentioned some), some of them (4 participants out of the 13 that preferred the software version) also stated non-performance-related criteria that made them favor the software version, which we will list below.

The non-performance related factors in favor of the software version centered on better group dynamics and on addressing preferences and needs of certain personalities better. ("*people did not try to assert their own ideas with bias*", in contrast to "*judgement within the team and no 100% free idea flow*" [in paper-based version], "*We could ideate without being interrupted by others*", "*easier for shy people to add their ideas*", "*You feel more satisfied while including any ideas even if it was not that unique*", "*easier to develop own ideas […], because you were not interrupted or distracted by other people*"). In addition, several participants stated that the software was easier or more comfortable to use.

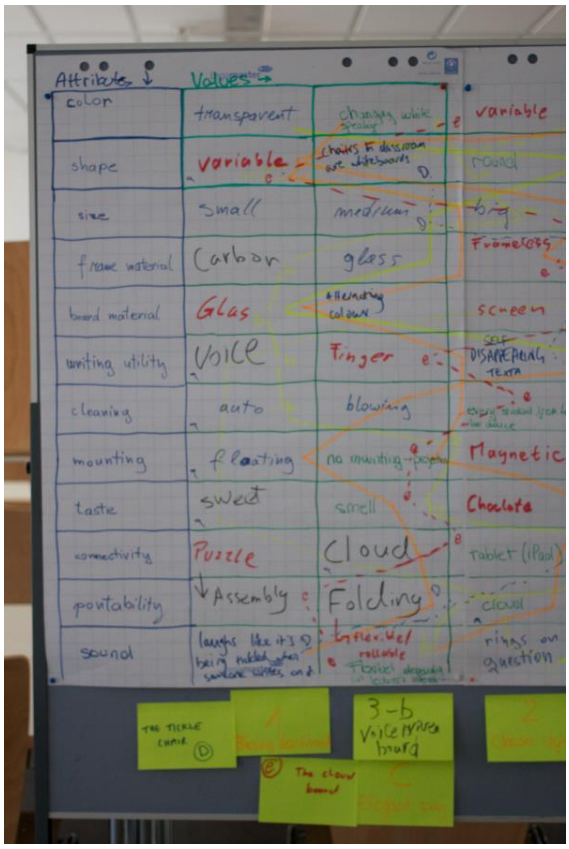


**Figure 3. Morphological box, combinations and some resulting ideas in a paper-based session**

In contrast, people who preferred the paper-based version only mentioned non-performance-related arguments. These non-performance-related arguments (some of them were also mentioned by neutral participants) primarily referred to better communication among team members, which allows participants to clarify and build upon other ideas ("*better building on teammates ideas*", "*better to transport the concept of an idea before rating*", "*to ask what the fellow students mean by certain terms*", "*pitching the final ideas on the flip chart seemed more beneficial in terms of discussing them in person*"). "*Communication*" or "*discussion*" were also mentioned by several participants in a more general sense without elaborating on concrete benefits. Other participants referred to a positive impact of the interaction on group well-being ("*More of a brainstorming for the whole team as a one group*", "*the Team Interaction was nice*").

One participant mentioned their individual needs were met better ("*you also could bend the system more easily to your personal workflow*"), another stated that "*due to less 'anonymity'* [Authors' note: the paper-based version] *had less 'bullshitting'*".

**Table 4. Number of ideas**

| | Software | Paper |
|---|---|---|
| **Number of ideas** | | |
| Team 1 | 19 | 15 |
| Team 2 | 24 | 13 |
| Team 3 | 17 | 7 |
| Team 4 | 26 | 26 |
| Total | 86 | 61 |
| Mean at team-level | 21.5 | 15.25 |
| SD team-level | 3.64 | 6.87 |
| Mean at individual level | 3.73 | 2.60 |
| SD at individual level | 0.46 | 1.08 |

As we can see in table 4, the number of ideas generated was higher in the software session (86 vs. 61 in the paper-based session). However, the feasibility and the originality of ideas was lower (table 5). This is in alignment with the participant's subjective self-assessment (see table 6). In terms of overall idea quality, participants should have preferred the paper-based version, also in terms of feasibility and originality (except for the negligible .04 higher rating of the quality of their team ideas in the software). However, they preferred the software variant with respect to task performance and some non-performance-related aspects. The latter are commonly perceived as benefits of verbal brainstorming.

Out of the four people who preferred the paper based version, three were in team 4. This is the only team that did not produce more ideas in the software session (26 ideas in both sessions).

**Table 5. Ratings of ideas within the sessions on a 7-point Likert scale (1 = low, 7 = high)**

| | Software | Paper |
|---|---|---|
| **Originality rating of ideas** | | |
| Team 1 | 4.18 | 5.07 |
| Team 2 | 4.29 | 4.75 |
| Team 3 | 4.24 | 4.39 |
| Team 4 | 3.73 | 4.09 |
| Mean | 4.11 | 4.57 |
| Standard deviation | 0.22 | 0.37 |
| **Feasibility rating of ideas** | | |
| Team 1 | 3.73 | 4.02 |
| Team 2 | 3.92 | 4.40 |
| Team 3 | 3.97 | 4.07 |
| Team 4 | 3.81 | 4.09 |
| Mean | 3.86 | 4.14 |
| Standard deviation | 0.09 | 0.15 |

**Table 6. Participants' responses on their satisfaction with the results on a 7-point Likert scale (1 = very unsatisfied, 7 = very satisfied)**

| Satisfaction with | Software | Paper |
|---|---|---|
| Overall quality of own ideas | | |
| *Mean* | 5.04 | 5.30 |
| *Median* | 5.00 | 5.00 |
| *Standard Deviation* | 1.16 | 0.86 |
| Overall quality of team ideas | | |
| *Mean* | 5.04 | 5.00 |
| *Median* | 5.00 | 5.00 |
| *Standard Deviation* | 1.33 | 1.22 |
| Own productivity | | |
| *Mean* | 5.17 | 4.61 |
| *Median* | 5.00 | 5.00 |
| *Standard Deviation* | 1.09 | 1.52 |
| Team productivity | | |
| *Mean* | 5.43 | 5.00 |
| *Median* | 5.00 | 5.00 |
| *Standard Deviation* | 0.82 | 1.50 |
| Feasibility of own ideas | | |
| *Mean* | 5.04 | 5.35 |
| *Median* | 5.00 | 5.00 |
| *Standard Deviation* | 1.23 | 0.91 |
| Feasibility of team ideas | | |
| *Mean* | 4.65 | 4.87 |
| *Median* | 5.00 | 5.00 |
| *Standard Deviation* | 0.91 | 1.33 |
| Originality of own ideas | | |
| *Mean* | 4.91 | 5.35 |
| *Median* | 5.00 | 5.00 |
| *Standard Deviation* | 0.93 | 1.20 |
| Originality of team ideas | | |
| *Mean* | 5.04 | 5.43 |
| *Median* | 5.00 | 5.00 |
| *Standard Deviation* | 1.33 | 1.01 |

We looked at the previously mentioned disadvantages commonly associated with verbal brainstorming.

The problem most evident to participants was production blocking. It was explicitly described by nine of the participants as either a drawback of the paper-based version or the absence thereof as an advantage of the software version (see analysis above on the parallelization of the process, with comments "*no discussion, which allowed for clear decisions regarding the validity of each idea [...] This was more efficient*", "*complete free working with judgement of others*" [Annotation of authors: vs. "*judgement within the team and no 100% free idea flow*" about the paper based version], "*everybody could work at the same time*", "*less time per person, and didn't waste time*", "*It was easier to simultaneously collect attributes and ideas*", "*easier to parallelize*", "*no time lost for arguing*", "*more efficient, whereas if you communicate together, you really use up all the time*", "*With 6 people crowded in front of the paper canvas, it was difficult to get working, as someone was blocking the view, paper, whatever.*"). Other comments on efficiency may refer to production blocking as well but were somewhat hard to interpret.

The avoidance of evaluation apprehension through the software was mentioned by four people ("*You feel more satisfied while including any ideas even if it was not that unique*", "*easier for shy people to add their ideas*", "*anonymous*", "*judgement within the team*" (Annotation by authors: the latter on the paper-based version).

We did not observe social loafing in the paper-based session. This is most likely due to the fact that the students were selected for the study program due to a higher than average motivation. Furthermore, the ideation session directly contributed to their curricular project work. However, with the participants being anonymous in the software session, social loafing might have been an issue.

## 4. Summary and Discussion

In traditional group brainstorming, verbal brainstorming is preferred over electronic brainstorming, although the latter can level out several drawbacks of verbal brainstorming (such as production blocking, evaluation apprehension and social loafing). According to Dennis et al. [2], a major reason is that users are not only interested in performance-related factors but also in softer factors such as group well-being and member support which they attribute to verbal brainstorming.

Looking at the arguments provided, in line with Dennis et al., non-performance-related factors did play an important role in participants' preferences. However, we found that with the more complex method of MA, factors leading to a higher task performance or better process support were the main decision factors for preferring the software solution over the paper-based version.

As Dennis et al. found in their survey among 131 MBA students, there are common expectations that lead to the preference of verbal brainstorming over electronic brainstorming. We expect to encounter expectations also regarding software-supported morphological analysis, which, however, may prove wrong or less important than arising benefits when participants actually experience the software, as our empirical study suggests.

Interestingly, all four individuals that preferred the paper-based version were in the two teams that

started with the paper-based session, whereas all participants of the teams that started with the software session preferred the software or were neutral. The underlying study was conducted with technology-affine participants of ages 20-29, who might be more open towards accepting software solutions for group tasks. Being enrolled in an add-on study program on Technology Management, their interest in technology is expected to be above average.

Also, within this study, people were highly motivated to perform the task given, as on the one hand, they were selected for the course program because of their above-average academic performance and motivation and on the other hand, the outcome of the task was directly relevant to their course work. Such a high level of motivation is not always the case in other organizational settings, which might somewhat limit the generalizability of the study.

In the case of the teams on this experiment, there was no designated team leader within the teams, so participants were on an equal level of hierarchy. Dennis et al. suggested that status is an important factor within brainstorming and is thought to be served better by verbal brainstorming. We think that members with a higher level of hierarchy within a group may indeed miss this "status auction" within an anonymous software process. However, we think that gamification mechanisms may counteract this drawback.

## 5. Conclusion and Future Work

Our study leads to the hypothesis that with regards to more complex group creativity processes, the employment of software can be beneficial over traditional, non-software based processes.

However, as in the case of traditional brainstorming, preconceptions regarding the benefits and/or drawbacks of creativity software vs. verbal techniques might be an obstacle to technology acceptance.

Preferences for the software session (13 participants) largely outnumbered preferences for the paper-based session (4 participants). However, the total sample size of 23 participants is relatively low. For further research, we therefore suggest a larger, quantitative study that tests the hypothesis generated within this study. In addition, comparing preconceptions with actual results after employing a software-based process may show gaps and lead to further hypotheses on how these could be bridged.

In a future study, it would be interesting to further investigate whether the order in which participants get to know a method has an impact on their preference.

This study focused on participants' subjective satisfaction. For future studies on objective performance, we suggest to include ratings by an external expert. Also, we suggest to investigate whether variability or homogeneity in acceptance influences team performance, behavior and/or group dynamics.

We also suggest further research on the main drawbacks mentioned with regards to the software (e.g. how to allow the clarification of questions on ideas, and on how to incentivize participants to build on ideas of others and to generate a sense of group belonging). In addition, elements that work well within smaller groups might not work as well in a larger group settings (e.g. open innovation processes).

In terms of practical relevance, the arguments in favor of the software solution found within this experiment may prove helpful in promoting the employment of software-based processes and in finding acceptance among decision-makers. In addition, software developers may work on addressing the current disadvantages mentioned by participants.

## 6. Acknowledgements

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# 4. Performance Feedback as Essential Element of Gamification

As performance feedback is an integral part of most gamification elements, it is worthy to investigate different aspects on how to best position it. With that goal, first the timing aspect of performance feedback is analyzed. Section 4.1 reports the results of a user study on an immediate feedback mechanism, which analyzes the acceptance of immediate feedback versus delayed feedback in a software-based ideation session.

Subsequently, both the desired content and the desired level of visibility of performance feedback are examined. In a questionnaire participants were asked which kind of feedback they desired, and to evaluate different levels of feedback visibility.

## 4.1. Study 2: Optimizing the Timing of Performance Feedback

To analyze whether participants in computer-assisted ideation processes prefer an immediate feedback mechanism to the traditionally separate phases of idea generation and evaluation, an exploratory study was conducted. This resulted in a conference publication [50].

Ideation platforms often follow the rules of traditional brainstorming, a well-known creativity technique introduced by Osborn [88]. In a traditional brainstorming session, the participants meet on site and express their ideas, following four rules proposed by Osborn: Not to allow criticism, to encourage *wild* or out-of-the-box ideas, to go for quantity and to try to combine and improve ideas. The same rules are also generally applied to idea generation processes, with the rule not to criticize being referenced as “defer judgement”. On the other hand, performance feedback is a central component of the most commonly employed gamification elements. An analysis of the acceptance and the perception of feedback during or only after the phase of active ideation has effects on the selection of gamification elements and their integration into computer-supported ideation processes.

The hypotheses of the study were that if feedback was preponed to the idea generation phase, participants would simultaneously be exposed to ideas of other, which would inspire them to generate more and higher quality ideas. At the same time they would take on the otherwise time-consuming task of evaluating ideas. By evaluating

the ideas of others, participants would be able to reflect on the standards of desired creative results. By reflecting on the ideas of others, they would identify success factors and obstacles, and therefore an immediate feedback mechanism would inspire and motivate them.

We had the participants generate ideas on an ideation platform under two conditions, one with immediate and one with delayed feedback, and opinions diverged widely: while about half of the participants (those with less motivation or skills for the task) preferred immediate feedback, the other half (the more motivated and able) preferred the delayed feedback phase.

This led to the proposition that people who consider themselves able and motivated with regards to the task prefer a feedback phase separate from the ideation phase, as they do not want to be distracted, while others prefer immediate feedback, benefiting from the inspiration and motivation from the immediate feedback mechanism.

The results can influence the design of collaborative idea generation platforms. For example, one can reward people who consider themselves as less motivated or less able with regards to the task (e.g. via points/badges) for evaluating ideas and dealing with the ideas of others, while participants who consider themselves already motivated and able might be given the time to focus on generating ideas and only be asked to evaluate ideas at a later point in time or when they run out of ideas. The study is reported on the following pages.

# Sooner or Later? – Immediate Feedback as a Source of Inspiration in Electronic Brainstorming

**Veronika Gamper**
Technische Universität Munich
Germany
gamper@cdtm.de

**Andreas Butz**
University of Munich (LMU)
Germany
butz@ifi.lmu.de

**Klaus Diepold**
Technische Universität Munich
Germany
kldi@tum.de

## ABSTRACT

Idea generation platforms are increasingly striving to become truly collaborative. Prior research suggests that people are inspired when being exposed to ideas of others. While most platforms defer judgment and separate it from the idea generation phase, we hypothesized that asking participants to rate ideas in the idea generation phase, the increased exposure to other people's ideas would serve as a source of inspiration and motivation and would therefore be preferred to a separate feedback phase.

In an explorative study with 26 participants we found that preference on immediate versus deferred judgment of ideas very much diverged. The results of our study suggest that participants that feel already motivated and able are distracted by the integration of feedback, while to others it is highly beneficial in terms of facilitating their idea generation and motivating them further.

## CCS CONCEPTS

• **Human-centered computing~Computer supported cooperative work** • *Human-centered computing~Collaborative interaction*

## KEYWORDS

H.5.3 Group and Organization interfaces: Computer-supported cooperative work

**ACM Reference format:**

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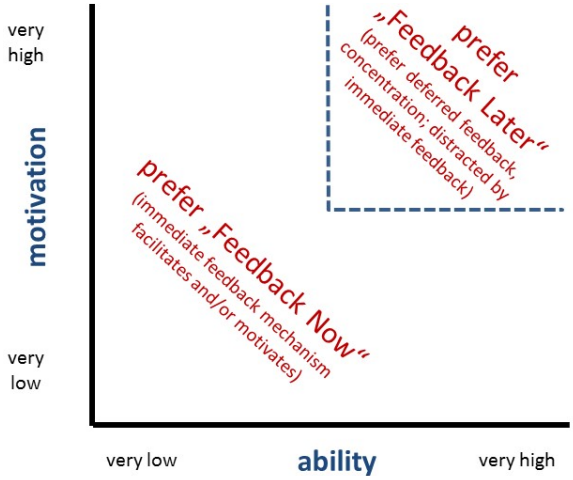


**Figure 1: Resulting proposition: People who feel motivated and able prefer deferred feedback, while the feedback mechanism serves as facilitator and/or motivator to others.**

## 1 INTRODUCTION

In today's dynamic economic environment, companies strive to be leading innovators in order to remain competitive [29]. They try to leverage internal knowledge and ideas and also reach out to external idea sources [6].

To capture the ideas of employees, both company-specific online platforms as well as third party solutions are being employed, and large companies, such as Audi, BMW and Siemens are developing their own ideation platforms to leverage ideas of their employees. These platforms are striving to be increasingly collaborative. Research shows that people benefit from the exposure to other people's ideas and that the "lone inventor" is a myth [26]. Exposure to example ideas can inspire people to generate own ideas [12, 15, 11]. The timing of the exposure to example ideas has an impact on participants' performance and should therefore be carefully examined [26].

Ideation platforms commonly follow the rules of traditional (in-person) brainstorming, the well-known creativity technique introduced by Osborn [21]. In a traditional brainstorming session, group members meet in person and speak out their ideas, following four rules proposed by Osborn: (1) Criticism is ruled out, (2) "free-wheeling" is welcomed, (3) quantity is wanted, (4) combination and improvement are sought. The same

rules are also applied to general idea generation, the rule not to criticize often being referred to as the rule to "defer judgment" [21, 22]. Rating on ideation platforms is mostly deferred (e.g. [20]) or limited to up- and downvoting or "following" ideas.

We hypothesized that by preponing feedback to the idea generation phase, participants would be forcedly exposed to other people's ideas, which in turn would inspire them to generate more and higher quality ideas. At the same time, they would be taking over the otherwise tedious task of rating ideas (for the final evaluation or for a pre-selection for a subsequent rating by experts). When rating other ideas, we hypothesized they would reflect about the standards of creative output. Being able to reflect about other ideas, thereby identifying success factors or shortcomings, we believed that an immediate feedback mechanism would inspire and motivate them in their ideation.

We let participants ideate in two conditions, one with immediate and one with delayed feedback, and opinions were highly divided: While approximately half of the participants (the ones with less motivation and ability regarding the task) preferred immediate feedback, the other half (the higher motivated and able) preferred delaying the feedback phase.

With this paper, we make the following contribution:

- We conducted an experiment to study the benefits of an immediate feedback mechanism as opposed to a separate, deferred feedback phase in online collaborative ideation. We analyzed preferences, reasons stated and connected these with performance in the two conditions as well as participants' (self-assessed) ability and motivation.
- Our study supports our hypothesis that immediate feedback can be preferable, but it also suggests that this is only the case for some participants.
- Based on participants' self-assessed motivation and ability, our proposition is that people that feel able and motivated prefer a separate feedback phase, as they do not want to be distracted, while others prefer immediate feedback as they benefit from inspiration and motivation (see Fig. 1).

Our results can influence the design of collaborative idea generation platforms. One can, for example, purposefully suggest less motivated or less able participants to rate and thereby expose themselves to other people's ideas, while allowing participants that are already motivated and able to concentrate during ideation, asking them to rate ideas later.

## 2 PRIOR WORK

As organizations now operate or form strategic alliances across the globe, virtual teamwork becomes increasingly important [19]. Hence, electronic brainstorming is a promising alternative to brainstorming in real meetings. Empirical research has furthermore pointed out several problems of face-to-face brainstorming, such as production blocking [9], evaluation apprehension [3] and social loafing [13]. In order to counteract these issues, electronic brainstorming has been proposed [8]. Electronic brainstorming systems are a subset of group support systems, in that they provide special purpose tools to support the exchange of ideas and comments in brainstorming sessions. Group support systems in turn are computer technology for group members to communicate by exchanging typed messages instead of or in addition to speaking [8].

The rule of "no criticism" or "deferred judgment" has been subject to discussion. While studies have found that participants who expected external evaluation were less creative [1], other research found that the instruction to debate and criticize may even outperform a setting with the instruction not to criticize [16]. Zhou [29] examined feedback in an organizational environment and finds that feedback can even promote creativity: a) Feedback can boost people's intrinsic motivation. b) Feedback can affect the mood state of a person. c) Feedback can clarify the standards of creative output, and d) it can help the recipient acquire creativity-relevant skills and strategies. The main reason behind the "defer feedback" rule is to counteract fear of evaluation. Cooper et al. [7] found that even non-anonymous electronic brainstorming resulted in more ideas than face-to-face brainstorming and participants reported less evaluation apprehension. Hence, we hypothesized that giving and receiving ratings in software-based ideation has less negative connotations than in face-to-face brainstorming.

With regards to the effect of exposure to example ideas, prior work found both positive and negative effects, with timing playing an important role. Early exposure to example ideas has been suggested to improve the creativity of ideas [14]. The SIAM theory (Search for Ideas in Associative Memory) states that, depending on when example ideas are shown, both positive and negative effects can occur [17, 18]. On the one hand, participants may get inspired [12, 15, 11], on the other hand, participants may experience "functional fixedness" or "fixation" by the examples they read ideas of others, without even being aware of it [23]. Prior research on the best timing for example ideas suggests that people benefit from examples when they run out of ideas [26]. Recent work has found that expert facilitation, providing inspiration extracted from incoming ideas, resulted in more creative and a higher number of ideas [4, 5]. We believe that even without expert facilitation, instead of giving mere up- or downvotes, rating and hence reflecting on the evaluation criteria while still in ideation phase and thereby extracting elements, may inspire participants in their own ideation.

In this paper, we investigate the users' acceptance of rating ideas during the idea generation phase in an electronic brainstorming system. We believe that while rating ideas during idea generation in a face-to-face brainstorming session may be detrimental, it could be a motivating and facilitating factor in an electronic brainstorming session. This contradicts the rule to defer judgment in divergent creative processes [21], but supports findings that feedback and exposure to other ideas can have a positive impact on motivation and output [29, 16, 12, 15, 11]. The hypothesis of our investigation was that users would prefer immediate ratings over a separate rating phase as they would find the immediate feedback mechanism inspiring and motivating. Our exploratory study focuses on users' satisfaction with delayed or immediate rating of ideas and on benefits or drawbacks of feedback throughout an ideation session.

## 3 METHOD

We conducted our field experiment in a course on technology management. As part of the curriculum, students had to generate ideas from a startup perspective on how to get access to financial resources and how to satisfy human resource requirements. We followed the following approach:

1. We developed a software prototype for computer-supported idea generation and evaluation and asked students to generate and evaluate ideas in two conditions:
   a) giving and receiving ratings on ideas within the idea generation phase, the so-called "Feedback Now" condition
   b) giving and receiving ratings on ideas at the end of idea generation, the so-called "Feedback Later" condition.
   We consequently evaluated the output generated by participants in the two conditions.
2. After the sessions, participants were asked to fill a questionnaire. From this, we gathered information on preference and satisfaction with the two conditions as well as qualitative data on their reasons for preference.
3. To verify our hypothesis resulting from steps 1) and 2), in a post-hoc test we sent a questionnaire to participants, asking for participants' self-assessed motivation and ability. The data, in combination with our findings from the previous steps, led to our proposition.

## 4 EXPERIMENTAL SETUP

We chose a within-subject design in order to examine preference of one condition over the other and reasons behind the preference. The participants all participated in two sessions, with different conditions and different topics (counterbalanced) in their first and in their second ideation session (see Table 1).

**Table 1: Counterbalancing conditions "Feedback Now" (FBN) and "Feedback Later" (FBL) and tasks (Finance, HR).**

| Session | Team 1 | Team 2 | Team 3 | Team 4 |
|---|---|---|---|---|
| 1 | FBN *Finance* | FBN *HR* | FBL *Finance* | FBL *HR* |
| 2 | FBL *HR* | FBL *Finance* | FBN *HR* | FBN *Finance* |

### 4.1 Participants

For our study, we recruited 26 students (ages 20-27) from an add-on study program on technology management, coming from mixed study backgrounds (9 Business Administration, 8 Computer Science, 3 Electrical Engineering, 1 Consumer Affairs, 1 Physics). They all had gone through the same recruiting process to be admitted to the program, consisting of a written application and two interviews on technological and business savviness in a case study and a personal interview on their motivation and drive, interest in entrepreneurship and previous work experience. The participants were all enrolled in a seven-week full time course and had already gotten to know each other during a three-day kick-off event. The experiment took place at the beginning of week four and at the beginning of week five, when students had already been working together in teams.

Coming from various backgrounds, but knowing each other to a certain extent, our participants reflect the profile of employees in company-internal ideation processes. As part of the course, students had to come up with ideas in the field of entrepreneurship. The ideas generated in the study could serve for their final assignment. They had received input by experts on the topic. Two participants were present only in the first session, two only in the second. Hence each condition had 24 participants (4 teams, 6 participants per team). We took into account only the 22 participants that attended both, as they could give a valid opinion on which condition they preferred.

### 4.2 The Prototype

We developed a software prototype, which lets teams collaborate on idea generation and evaluation.

*4.2.1 Requirements.* While there is a variety of tools allowing participants to enter and rate ideas, our specific setting (immediate rating vs. delayed rating) and the need to allow for a fast mastery of the software came with additional requirements:

- Simple onboarding of participants so they could focus on their tasks (and not the software)
- Real-time feedback/display of user interactions of members of the same (virtual) team
- Supporting two conditions, namely allowing rating during the idea generation phase versus delayed rating and displaying ratings immediately or at the very end.

This corresponds to requirements for creativity support tools as elaborated by Shneiderman et al. [25], which include a low threshold to use the software, support of many paths and styles as well as support of collaboration and open interchange.

*4.2.2 Implementation.* We built a web-based group ideation software prototype. The implementation is based on a Ruby-on-Rails Backend, Angular and a Redis database. To ensure an easy onboarding of users, we used well-known elements from Google material design. The Redis database allowed for real-time display of newly generated ideas and real-time visualization of ratings.

*4.2.3 Implementing Immediate and Delayed Feedback.* While in the "Feedback Now" condition participants could rate others' ideas as soon as they were entered and see the average ratings of ideas displayed in the feedback matrix at all times, in the "Feedback Later" condition the rating was done in a separate phase after ideation and the feedback matrix was only displayed at the very end. In accordance with the definition of idea quality by [10] as a combination of originality and feasibility, we chose these as factors for idea evaluation, forming the axes of the feedback matrix (see Fig. 2 and Fig. 3).

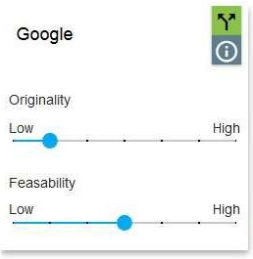


**Figure 2. Rating Levers on idea, example.**


**Figure 3. Feedback matrix, example.**

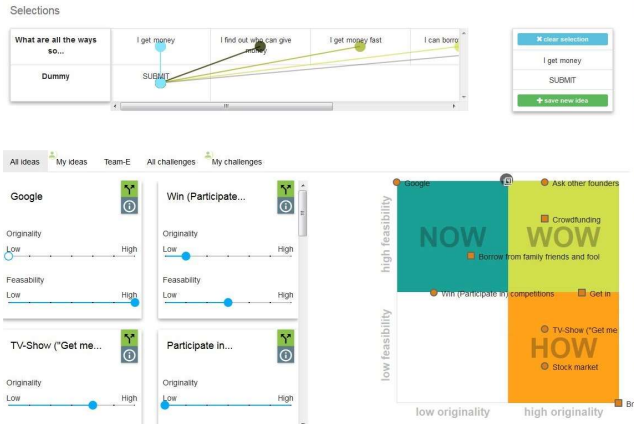


**Figure 4. Idea generation phase in "Feedback Now" condition: Rating levers are displayed, the results matrix shows current average idea ratings.**

"Feedback Now" condition: The two rating levers and the results matrix were available all throughout the session, the matrix was updated any time a rating occurred and displayed the average idea ratings by all participants (see Fig. 4).

"Feedback Later" condition: As rating was a separate phase, the rating levers were not shown during ideation (see Fig. 5), but only in the subsequent phase. Also the results matrix was only displayed in the rating phase. It displayed the own ratings of others' ideas. At the end of the session, the average ratings of all participants were displayed in the matrix. Hence, feedback was given and received, but only at the end of the session.

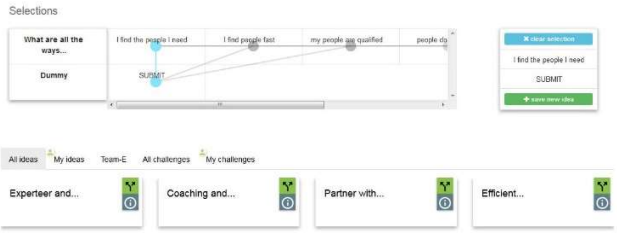


**Figure 5. Idea generation phase in "Feedback Later" condition: No rating levers or results matrix.**

*Generating an idea* consisted of entering a name for the idea and optionally adding a description. Participants could choose to add ideas in two ways: a) They could select one or more inspirational questions by clicking the respective buttons and then select "save new idea" b) They could build on ideas (either their own or those of other participants) by clicking a "build upon" button and adding their idea. The inspirational questions were the following: What are all the ways so... I get money / I can find out who can give money / I get money fast / I can borrow money / I can show I'm worth it (for the task on Finance). What are all the ways so... I find the people I need / I find people fast / my people are qualified / people don't leave / I make people learn faster (for the task on HR).

*Rating of ideas* was possible for all ideas except for the participant's own ideas. Clicking on an information button, they could read the description of the idea. Rating was based on two criteria, originality and feasibility, each to be rated on a scale from 1 to 7. The rating results were displayed in the feedback matrix. As described before, participants in the "Feedback Now" condition saw rating levers and could hence rate ideas during the ideation phase, and they could see the current idea ratings in the results matrix. Participants in the "Feedback Later" condition were not shown rating levers and feedback matrix during the ideation phase. They could rate in a subsequent phase and subsequently shown the results matrix. Participants could switch between the "My Ideas" and "All Ideas" tabs, where accordingly only the own ideas or all of their team's ideas were displayed. In both conditions participants could see other people's ideas.

## 4.3 The Experiment

We held sessions with two teams (12 participants) contemporarily. Participants sat interspersed across the room and could not see other participants' screens. A moderator showed how ideas could be added and rated by means of an example and then presented the tasks. The goal was to generate ideas for a startup, specifically ideas to fulfill a startup's needs in the field of finance and HR.

On finance: *"Imagine you are part of a startup team of five people. You are currently looking for Series A funding. You firmly believe in your idea, which is about an app that connects people in the new sports trend "Avalooning" and keeps track of their data. The goal of your ideation session is: To come up with new ideas on all the ways how you would solve the needs mentioned regarding Finance."*

On HR: *"Imagine you are part of a startup team of five people. You are currently looking for Series A funding. You firmly believe in your idea, which is about an app that connects people in the new sports trend "Avalooning" and keeps track of their data. The goal of your ideation session is: To come up with new ideas on all the ways how you would solve the needs mentioned regarding HR."*

In the "Feedback Later" condition, we granted 20 minutes for idea generation plus 10 minutes to rate the ideas. In the "Feedback Now" condition we granted 30 minutes for the combined idea generation and rating phase to provide a comparable experience. Participants logged in with a user id, which allowed them to stay anonymous within their group. They were not allowed to talk, as the session was purely online. Depending on the condition, there was a separate or a combined idea generation and rating phase. After the experiment, participants answered a questionnaire on their experience.

## 5 RESULTS

Based on the questionnaire, we evaluated participants' preferences and found them to be highly divided across all teams. We further analyzed the reasons for preference and found that the feedback mechanism was considered motivating and facilitating by those preferring that condition, while it was considered distracting by the others. We then looked at the output (number of ideas generated, originality and feasibility), which could influence the perception of the session. We report the results in the subsequent sections, starting with an analysis of team output, continuing with an analysis of individuals' performance overall and subsequently by preference group.

As performance data showed high variation, to clearly explain preferences we consequently sent out a post-hoc questionnaire, asking participants about their perceived level of ability and motivation regarding the task. The mapping on a graph and its analysis led to an interesting proposition, which will be presented at the end of this section.

### 5.1 Preferences and Reasons Stated

Participants were asked to indicate their preferred condition ("I preferred the rate later version / the rate now version / none, as I liked both the same"). Surprisingly, preference was highly divided among the two conditions, dividing participants into two large preference groups (see Fig. 6). Participants were also asked to rate their satisfaction with each condition ("I liked working with the version where I rated ideas during the idea generation phase (rate now)."/"I liked working with the version where I rated ideas in a separate phase (rate later)."., on a 7-point Likert-scale, 1=strongly disagree, 7=strongly agree). We excluded the two participants who stated their knowledge of the creativity rule of deferring feedback as the main and only reason for their preference. Out of the remaining 20 participants, only one was indifferent. 10 participants preferred "Feedback Later" with separate phases for idea generation and idea evaluation as suggested by Osborn [21], while 9 preferred "Feedback Now". Worthy of noting is the fact that participants' preferences were mixed within each of the four teams.

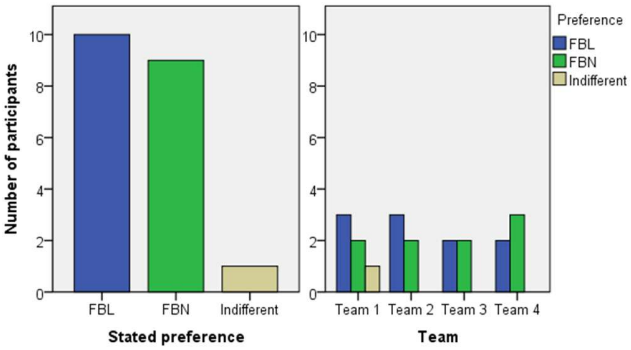


**Figure 6. Number of participants preferring the different conditions, entire group (left) vs. individual teams (right).**

Fig. 7 depicts participants' answers on liking to work with the two conditions. Satisfaction was overall higher with the FBL than with the FBN condition, with some participants' satisfaction being quite high and some quite low for both conditions.

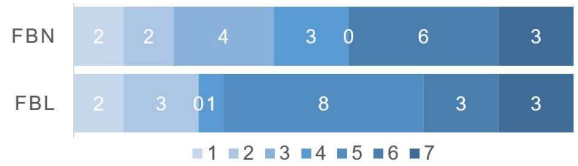


**Figure 7. Distribution of participants' ratings on how much they liked working with the two conditions, on a 7-point Likert scale.**

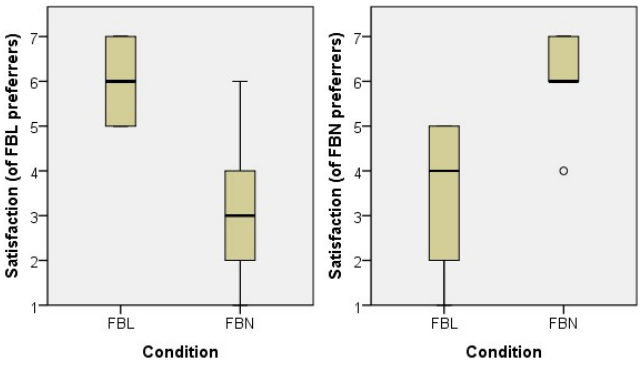


**Figure 8. Participants on how much they liked working with the two conditions by preference group.**

Fig. 8 depicts the data by preference group: For both groups, the preference for a condition over the other was rather strong. Below, we summarize the main line of arguments.

#### 5.1.1 *Arguments of "Feedback-Later" preferrers*

The main line of argument in favor of separating the two phases (the "Feedback Later" condition) was better concentration / not being distracted (*"You could concentrate on your own ideas without getting bias"*, *"I can concentrate on one thing"*, *"less chaotic, concentrate more on generating many ideas"*, *"Gives one*

*more time to reflect and rethink"*, *"Idea rating is distracting while you generate ideas. You should be completely free from distraction when you generate ideas."*). Three participants referred to liking the structure of having two separate phases or missing it in the other condition, respectively (*"It was a more structured process. And the evaluation did not really deliver value during the idea generation."*, *"I think it makes sense to have a shorter ideation phase and then a dedicated amount of time to rate each idea."*, *"Mixes up the ideation"*).

#### 5.1.2 *Arguments of "Feedback-Now" preferrers*

Participants that preferred the "Feedback Now" condition almost all stated that the feedback mechanism supported them by inspiring them, in general and also specifically when they ran out of ideas. Their main line of argument revolved around the feedback process inspiring them to come up with new ideas, by reflecting on existing ideas and building upon them (*"New ideas pop up while rating and get lost if creation is closed"* [authors' annotation: 'if creation is closed' refers to the "Feedback Later" condition], *"It gives you an idea about how your idea is doing or how any idea is doing and you can build on it accordingly."*, *"...feedback helps to think about new ideas"*, *"...Rating ideas directly made me think about other ideas, and if I rated them low, I could immediately come up with an alternative that I thought would be better."*). Some participants mentioned running out of ideas and the feedback mechanism consequently motivating them to stay active (*"I like working interactively, so when you were running out of ideas for 5 minutes you could start ranking ideas, and when another idea hit you, you could continue with it. ..."*, *"The generating-phase was much too long in the first version and I ended up doing nothing, after I used up my ideas."* [authors' annotation: 'the first version' refers to the "Feedback Later" condition]). Two participants mentioned efficiency (*"You have to read the information thing twice, first if you want to build your ideas on others and later when you vote on them"*, *"Didn't have to read ideas twice - once while generating ideas to see what is already there and then again when rating."*).

In sum, the reasons stated suggest that the same feedback mechanism was considered distracting by the FBL preferrers, while it was considered helpful by the FBN preferrers, who mentioned the following main benefits: Inspiration (by reflecting and building upon other ideas and feedback), especially when running out of ideas and motivation to stay engaged on the task. According to the statements, these benefits were not considered relevant or actually considered disturbing by the FBL preferrers.

## 5.2 Analysis of Performance

We analyzed performance mainly with regards to its influence on users' satisfaction. Therefore, we base our performance analysis on the team-internal ratings, i.e. the information participants had access to, which could influence their satisfaction. We report the number of ideas and ratings on originality and feasibility, adding statistical test results where the number of observations was large enough for reliable statistical test results (i.e. where the number of observations was equal or greater than 30). For smaller samples, we report descriptive statistics and graphical representations of the data. We start with an overview of team performance, then report performance of individuals.

#### 5.2.1 *Performance on a Team-Level, Based on Team-Output*

As shown in Fig. 9, two teams generated considerably more ideas in the "Feedback Later" condition. With regards to team-internal idea ratings, team 1 performed better in "Feedback Later" regarding originality (M=4.03) and feasibility (M=3.80) than in the other condition (M=3.42, p=.001 and M=3.15, p=.000, respectively). Team 4 performed better regarding feasibility in "Feedback Later" (M=4.32) than in "Feedback Now" (M=3.83, p=.011). Other differences were not significant.

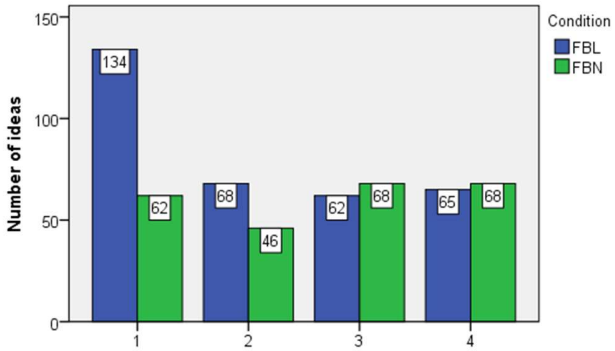


**Figure 9. Average number of ideas, by team.**

As across all teams preferences were highly divided (Fig. 6), team-level performance by itself did not explain preference. Also the reasons of preference pointed towards decisions based on individual performance, which we hence analyzed.

#### 5.2.2 *Performance of Individual Participants*

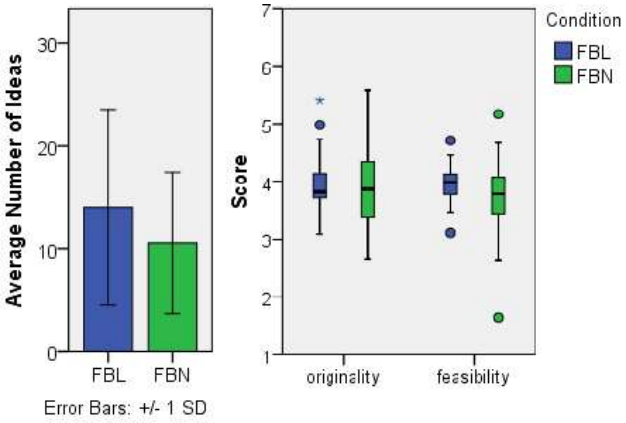


**Figure 10. Comparison of individuals' performance: Average number of ideas, originality, feasibility.**

On an individual participant basis, we analyzed the scores of the 22 participants that attended both sessions. Although participants on average generated a higher number of ideas in the FBL condition, there was a high standard deviation (Fig. 10). Originality and feasibility did not differ much, however showing higher variability in the FBN condition.

*5.2.3 Performance of Individual Participants by Preference Group*

Individual performance by preference group is depicted in Fig. 11. On average, FBL preferrers created more ideas than FBN preferrers in both conditions, but standard deviation was very high, the high average number of ideas hence attributable to few highly active participants. FBL preferrers' originality and feasibility showed a considerably higher variability in the FBN condition. This supports some FBL preferrers' statements that they were distracted by the Feedback mechanism, although some must have benefitted from it with regards to originality and feasibility. FBN preferrers' feasibility and originality varied less, with slightly lower scores in the FBN condition.

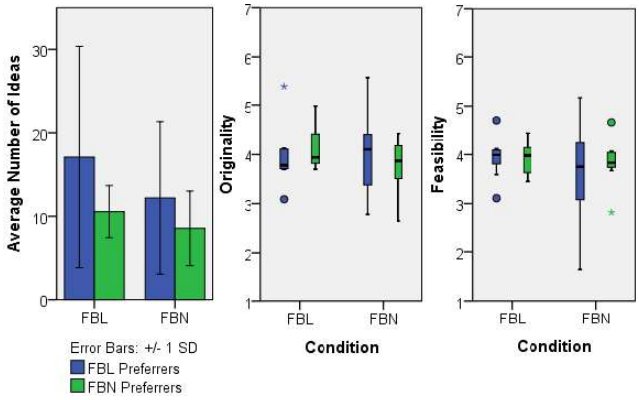


**Figure 11. Comparison of preference groups in both conditions: Average no. of ideas, originality, feasibility.**

As mentioned before, participants' reasons for preference suggest that the benefit of the feedback mechanism of being a source of inspiration and motivation was not relevant to FBL preferrers. This could be the case if they were more able and motivated at the task, hence they might not need as much motivation or facilitation. Our performance analysis by preference group was inconclusive about this, due to high variations among participants' performance and number and quality of ideas potentially outweighing each other, while all possibly influencing satisfaction. We then conducted a post-hoc test, to verify whether FBL preferrers' self-perception of their ability and motivation was higher, as this could explain why they stated a need for concentration (thus relying mainly on their own ideation, being less open towards inspiration from outside) and did not report running out of ideas.

## 5.3 Ability, Motivation and Preference

Three weeks after the experiment, we sent participants a questionnaire on their motivation, their level of creativity and their knowledge about the topic – in accordance with Amabile's three components of individuals' creative insight: Task motivation, creativity-relevant processes and domain-relevant skills [2]. Additionally, next to motivation, we asked for creativity and/or knowledge as they were the abilities required to generate the desired output in terms of rating criteria: originality (need for creativity) and feasibility (need for knowledge on the topic). We posed the following questions: a) motivation regarding the task: "I am motivated to come up with ideas regarding the finance or hr needs of startups", b) creativity ("I am a creative person") and c) knowledge regarding the task ("I feel knowledgeable about the field of finance/HR needs of startups" (topic from their FBN condition), each on a 7-point Likert scale from strongly disagree to strongly agree. We posed them in present tense to allow a general self-assessment of participants. Of the 20 answers we could map 18, nine for each preference group. One participant did not answer and, as before, we excluded the two participants that had mentioned the rule of deferring feedback as only reason for their preference. We then mapped participants' answers on a graph (Fig. 12).

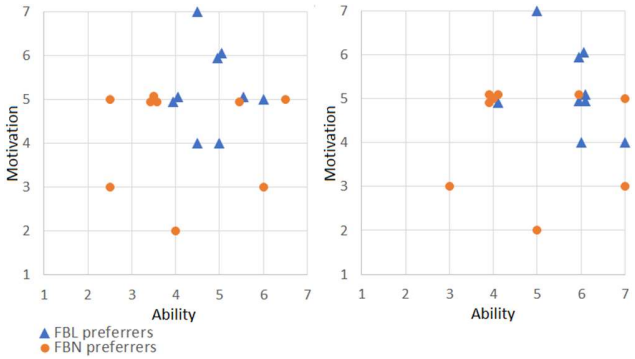


**Figure 12. Mapping participants' ability and motivation with preference. Ability as average (left) and maximum (right) of creativity and knowledge. For clarity, we shifted overlapping dots by up to 0.1 units.**

We chose ability and motivation for the axes, as they correspond to the two main benefits of the Feedback mechanisms mentioned, namely inspiration (thus impacting ability) and motivation. We took the motivation score from the questionnaire for the y-axis (see Fig. 12). For the x- axis of the model ("ability"), we show two versions (thus two graphs): a) left graph: We took the average of creativity and knowledge scores as the deciding factors for the ability to generate ideas of the desired quality (original and feasible), hence for the ability to do well in the task. b) right graph: The right graph represents the assumption that to be able to do the task at all, creativity or knowledge about the topic alone were sufficient (although possessing both would result in higher scores). In fact, one could also merely come up with creative ideas or ideas based on factual knowledge. For the ability score in the right graph we therefore took the maximum of creativity and knowledge score. As the results could serve participants for their course deliverables, we assume most participants wanted to perform well both on

originality and feasibility (left graph), however we report the right graph for the assumption that the overall quality of ideas was less relevant.

As the graphs in Fig. 12 depict, the combination of high motivation and high ability highly coincided with preference of "Feedback Later". Participants who felt less motivated and/or able preferred the "Feedback Now" condition.

## 6 SUMMARY AND DISCUSSION

While electronic brainstorming becomes increasingly important, often the rules of traditional brainstorming are followed [21], establishing separate phases for ideation and evaluation. We hypothesized that a feedback mechanism within the idea generation phase would be preferred over a separate feedback phase. Prior work suggests that exposure to others' ideas inspires participants [12, 15, 11], improving output and motivation [29, 16]. We believe that participants could be enticed to reflect about the desired standard of output. However, this contradicts the rule of deferring judgment [21, 22], in addition to possible detrimental effects, such as fixation of the problem solution space or distraction from the task [23, 24]. To investigate whether a feedback mechanism during idea generation may make sense, we conducted a field experiment in which users could experience ideation sessions with and without an immediate rating of ideas.

We looked into users' preference and their arguments. Preferences divided the group into two large fractions, one preferring immediate feedback, the other preferring deferred feedback, with notable differences in satisfaction between the preferred and the less preferred condition. While those in favor of mixed phases considered the rating mechanism a source of inspiration and motivation, especially when they ran out of ideas, the others were distracted by it. A mapping of perceived ability and motivation to preference suggests that people who preferred the "Feedback Later" condition considered themselves motivated and able regarding the task, while those who preferred "Feedback Now" regarded themselves as less able and less motivated. Our analyses suggest that the feedback mechanism can be facilitating and motivating, but not for everyone. It leads to our proposition that people that feel already motivated and able do not need to read and rate other people's ideas for inspiration, but that they even find it distracting. Fig. 1 summarizes the resulting proposition.

In line with prior work pointing out the importance of when examples are delivered to participants [26, 17, 18, 24, 23], our study adds the importance of segmenting participants according to their (self-assessed) motivation and ability when including an immediate feedback mechanism. Prior research suggests that examples should be presented when the user is ready to make use of them, and that it is mostly beneficial when people run out of ideas, as then examples can act as external stimuli [26]. Our research supports this: Support when running out of ideas was a major reason for preferring immediate feedback. It goes in line participants deeming themselves less motivated and/or less able preferring the immediate feedback mechanism. We support the suggestion that participants should be able to decide for themselves when to expose themselves to other examples (see "on-demand" condition in Siangliulue [26]) and possibly be "nudged" to do so whenever the system detects that they run out of ideas, in a subtle way (i.e. in a way that does not interrupt them in their ideation "flow"). This is furthermore in line with the request for the development of creativity support systems that "support many paths and styles" by Shneiderman et al. [25].

## 7 LIMITATIONS AND FUTURE WORK

In this study, we focused on motivation for users and their preference for immediate versus deferred rating of ideas. The feedback mechanism served a double purpose: It made participants read and think about others' ideas, thereby inspiring them, and it created the actual feedback. If the focus was on an objective measure of idea quality, external ratings would be required. Our participants were students, selected for their above average interest in entrepreneurship and innovation, hence some findings may not be generalizable.

Our post-hoc questionnaire was sent out three weeks after the experiment. Our questions did not require recalling the exact condition at the time of the experiment, but rather ask for the person's general motivation for the task, their self-assessed level of creativity and their knowledge of the topic, which we believe to have been quite stable between the two points in time. However, answers on the day of experiment might have differed.

Due to a limited number of participants and the strong exploratory focus, we reported data mainly via descriptive statistics and graphical representations. Our findings however can point towards interesting avenues for future work. We propose to conduct a larger study in order to verify our proposition that immediate feedback can have a very different impact which may depend on the users' perceived ability and motivation. This could influence the way idea generation is conducted in the future, e.g. determining the type and timing of feedback in ideation processes.

## 8 CONCLUSION

In our study, we conducted an experiment to explore acceptance of an immediate feedback mechanism in idea generation, comparing it to idea generation with a separate rating phase and found highly diverging preferences. From our findings, we conclude that there is not one condition that largely outperforms the other in terms of user acceptance, but that both immediate and deferred ratings have benefits, and this may depend on the users' perceived ability and motivation for the task.

There are several recommendations for practitioners that could be derived: First of all, a feedback mechanism within the idea generation phase can work better for some individuals than for others. Individuals that already feel motivated and able may require undisturbed phases when they can concentrate and work by themselves, while others may be stimulated by being exposed to other people's ideas. For the latter, a feedback mechanism such as the one in this study, and the well-timed encouragement to rate other people's ideas, may be highly beneficial.

## 8 ACKNOWLEDGEMENTS

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## 4.2. Prototype Evaluation and User Interviews

A prototypical implementation of the most common gamification elements served to gain a deeper insight into the most promising design, advantages and disadvantages in the context of a collaborative ideation platform.

As gamification experts report and literature on gamification [57] shows, points, badges and leaderboards are the most commonly employed gamification elements, also in the context of computer-supported ideation. In order to explore the preference for certain gamification elements in an online ideation context and to compare the desire for receiving certain performance feedback about oneself with the willingness to disclose the same to others, I designed a questionnaire. It was composed of questions on six different levels of visibility of performance feedback:

1. I'd like to see about myself
2. I'd like to see about my team
3. I'd like to see about other people of my team (Note by the author: referred to as 'other individuals' in the subsequent tables)
4. I'd like to see about other teams
5. I'd like others to see about myself
6. I'd like others to see about my team

Each question on a certain level visibility was supported by a conceptual example. Participants were asked to indicate their level of agreement to wanting to see and wanting to allow others to see a certain level of performance on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Ten frequently employed gamification elements [57]) (reported in Table 4.1) were proposed. For the six levels of visibility, participants were then asked to indicate to what extent they would like to see the respective gamification element. Some combinations did not make sense and hence were not proposed. Table 4.2 displays the combinations that participants were proposed in the questionnaire.

| Element | Abbreviation |
|---|---|
| **a results score on performance** | Score |
| **a results score on performance on certain tasks** | Score_Tasks |
| **compare results to a previous time period** | PreviousTime |
| **focus on certain tasks** | Focus |
| **badges received automatically for things done well** | Badges_Automatically |
| **badges received by people for things done well** | Badges_ByPeople |
| **to showcase ideas generated or contributed to on own profile** | ShowcaseIdeas |
| **to see a leaderboard comparing oneself to other people of the own team** | Leaderboard_MeVsPplOfOwnTeam |
| **to see a leaderboard comparing oneself to the other people of the own team and the people of the other team** | Leaderboard_MeVsAllPpl |
| **to see a leaderboard comparing the own team to the other team** | Leaderboard_TeamLevel |

**Table 4.1.:** List of gamification elements that were part of the questionnaire and their abbreviations used within this dissertation

| | Me about myself | Me about my team | Me about other individuals | Me about other teams | Others about myself | Others about my team |
|---|---|---|---|---|---|---|
| **Score** | x | x | x | x | x | x |
| **Score_Tasks** | x | x | x | x | x | x |
| **PreviousTime** | x | x | x | x | x | x |
| **Focus** | x | | x | | x | |
| **Badges_Automatically** | x | x | x | x | x | x |
| **Badges_ByPeople** | x | x | x | x | x | x |
| **ShowcaseIdeas** | x | x | x | x | x | x |
| **Leaderboard_ MeVsPplOfOwnTeam** | x | | | | x | |
| **Leaderboard_ MeVsAllPeople** | x | | | | x | |
| **Leaderboard_ TeamLevel** | x | | | | | x |

**Table 4.2.:** List of gamification elements and the visibility levels they were proposed for in the questionnaire

After filling the questionnaire, the prototypical representation corresponding to the participant's choices was displayed and then discussed. Two views were given:

a) the view to the participant, and

b) the view as it would appear to a fictional participant named Chris, claimed to be part of a second ideation team

Figure 4.1 depicts an exemplary screenshot of the results presented to the users. Figure 4.2 depicts participants' answers on their preferences.

The highest rated visibility levels were:

1. Me about my team (M=4.24, 0.41)
2. Me about myself (M=3.86, SD=0.57)
3. Others about my team (M=3.69, SD=0.54)

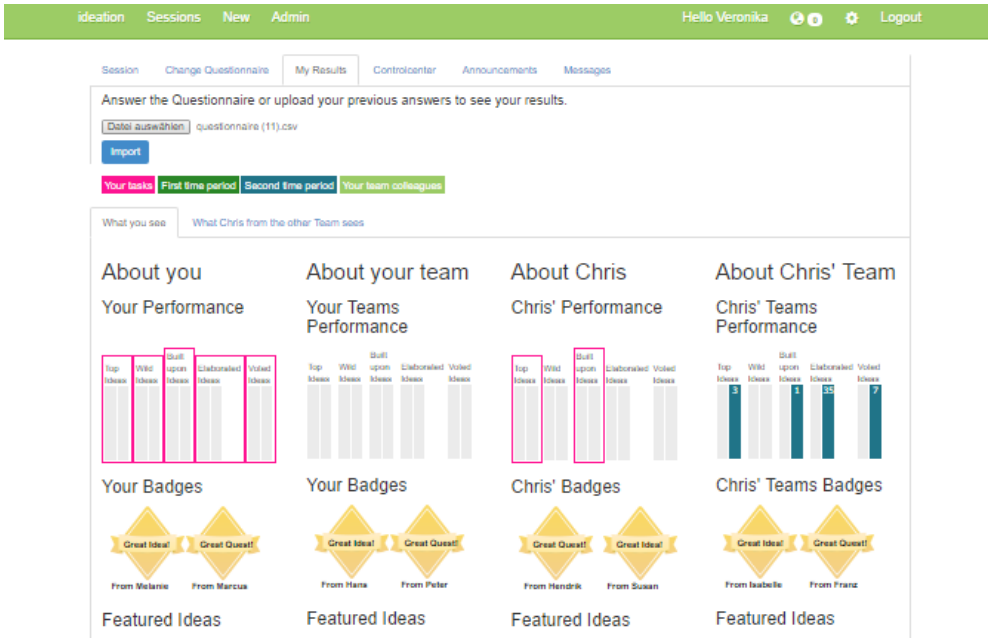



**Figure 4.1.:** Screenshot of the prototype displaying the results from participants' answers on the questionnaire.

Participants were most willing to learn about the performance of their own team (see Figure 4.2), followed by learning the performance of themselves and letting others know about their team performance. They were least willing to disclose information about their individual performance to people outside their own team.

Figure 4.3 depicts mean values and standard deviation for the desire to see the gamification element. The element rated highest was *ShowcaseIdeas*, followed by *Score*, *Badges_byPeople*, *Badges_Automatically* and *Score_Tasks*. The statements participants gave in the interviews supported this. The elements *Leaderboards* and *PreviousTime*, proposed only for some visibility levels, were not rated well overall. Only at team level, the element *Leaderboard* achieved an average value above 3 on the 5-point Likert scale.

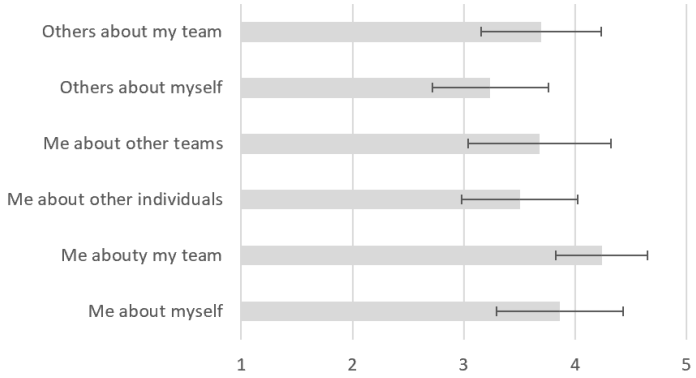



**Figure 4.2.:** Preferences for the various levels of visibility, averaged over the answers given for the six elements that were available in all six visibility settings

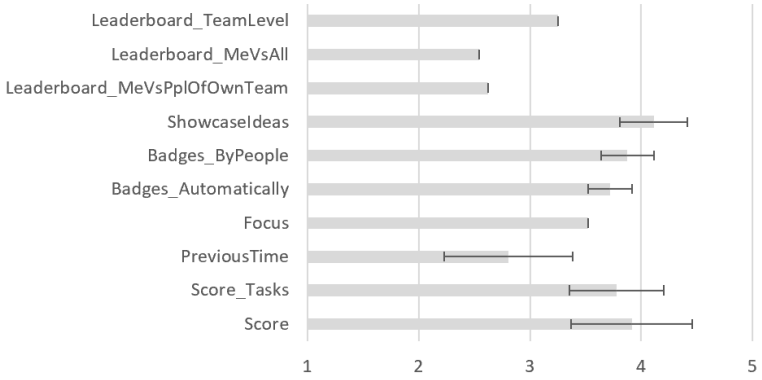



**Figure 4.3.:** Preferences for the various gamification elements, averaged over the different visibility settings the respective gamification element was proposed for

Across all elements and visibility levels (see Appendix), the three preferred options were:

1. *Score* in “Me about my Team” (M=4.58, SD=0.64)
2. *ShowcaseIdeas* in “Me about my Team” (M=4.50, SD=0.50)
3. *ScoreTasks* in “Me about my Team” (M=4.33, 0.75)

While participants overall were positive towards feedback on their individual performance for themselves, in many cases they did not want to disclose this information to others. Furthermore, they would rather disclose their performance at team-level to others than to disclose their individual performance.

**User Interviews**

The perception of and preference for certain gamification elements was quite different from participant to participant. The following excerpts from the interviews, that took place directly after participants had filled the questionnaire, provide some insights on the reasons for preference. In this section, I report some relevant statements of the participants from the interviews.

I asked participants on their percepetion and their preference with regards to the gamification elements they were presented. First, I looked at badges, whether people preferred them to be assigned automatically or whether they preferred them to be assigned manually by other participants. Overall, automatically assigned badges were deemed to be fairer, but more impersonal, while personally assigned badges were seen as less comparable from person to person, but more effective. Below some of the most insightful quotes are reported.

I started by asking people about badges. While they were generally rated positively, people’s opinion diverged on whether they preferred automatically assigned versus personally assigned badges:

> “In principle, I find both quite nice at first look. I find the personalized almost more exciting.” [P_a]

> “in principle, at first glance, I would say, automatically generated badges are more meaningful, there really is something behind them, this person has done this and that. ... when I see at first sight: Okay this person has this and that badge. So for example like in a forum, if you get badges for the number of posts or something like that, then I just know at first sight, yes this person brings in a lot and that is now something else than, this person has a badge by this and that user and I have no idea who this and that user is, especially when I am new on the system ... the personal ones don’t really make it comparable.” [P_b]

> "the badges ... that's a bit the reason for personal motivation. I think it's nice if you can somehow reach a certain goal ... I think it's important ... that they are somehow continuous, that maybe you don't get a badge for every little thing, but also that you don't have to work for hours and hours" [P_a]

The following quotes give insight into the different opinions participants have on automatically assigned badges:

> "Well, of course it depends a bit on how they [annotation by the author: the automatic badges] are calculated and also a bit on the fact that you don't get them too easily. So if I now just get a badge for every idea I enter, then the badges are ultimately worth nothing. That means, it has to be somehow clear that you have somehow shown a certain performance to get the badge..." [P_c]

> "In principle, I think quantitative badges that are linked to the number of ideas or to speed or to anything measurable, for example, are good if they are automatically assigned. Qualitative badges ... I would rather want to receive them from other participants. Because I think I just wouldn't trust A.I. enought to be able to evaluate whether something was indeed good or not" [P_c]

> "I think the badges are pretty cool ... maybe more the automatically assigned ones because they're more transparent and ... that's stuff that you collect. ... for example if one team collaborates extremely much and people give each other badges all the time, but another team is just as good, but doesn't do it that way, then it's unfair for them. ... And if you have very clear criteria in the algorithm that assigns the badges, then these [badges] are also much more meaningful. And I think that's why one should use the automatically assigned badges." [P_i]

> "What I really liked was this idea of giving the others badges, because that is ... such a more direct feedback. ... Because then you know there's not an algorithm behind it ... but people have spent thoughts about it, they have read my stuff and also tell me it's cool. And I find that very motivating then ... Whereby I believe, with these automatically generated ... I do not think they are necessary. Because if they do, people engage for other things." [P_e]

Featuring ideas is considered useful for keeping an archive of ideas, for presenting oneself to others and, thirdly, for assessing other teams:

> "I put them as second place, these featured ideas. So I just liked it that I thought I have my own profile, that is, I can see for myself, what ideas have I contributed, maybe later when I do another project, another ideation session or task, maybe I can have a look again and say, oh I then had a cool idea, a sort of collection of my ideas. The same with a team, that maybe when you use such a tool a little longer, that by looking at these featured ideas, you can see what kind of team was it, did they maybe go into another direction than another team" [P_a]

> "so I think it's super important, although I think I would like to choose which idea I feature. ... if I can choose them myself, then I think it's very good, because you can create your own portfolio..." [P_e]

The temporal comparison with oneself (element 'previous time') was mentioned as possibly more motivating than comparing oneself against others, as it is easier to beat yourself than to beat the competition:

> "Well, I think it is definitely interesting to get detailed feedback, especially in combination with past performance. ... if you would do this as a challenge against someone else, I see the risk, somehow, that it might be demotivating if you are too far behind. But if you have the challenge against yourself, then I can imagine that this is motivating, because of course you always have the possibility to beat yourself. Against another person this might not be the case." [P_c]

Leaderboards were not well liked by the participants.The reasons given were: 1) the difficulty to reach top positions being demotivating, 2) a competitive character in a collaborative task being seen as counterproductive. Leaderboards on a team level instead of on a personal level were more accepted.

> "I would just ... take out the leaderboard because I personally might be interested in it, but it can also have a demotivating effect, because even if I were highscoring everywhere, I just wouldn't want the others to necessarily see it, because I think it could somehow have a negative effect on the team dynamics in the worst case." [P_c]

> "Because it's usually so hard to get into the leaderboards, I don't care about them when I see them. But I also know, there are people who are eager to get into these [leaderboards] ... for some it might be motivating" [P_e]

> "I didn't find them so interesting because it's kind of a race for the best score. But actually one wants to develop *good* ideas somehow. I think that could be a side effect that somehow, I don't know how the scores

> are [Annotation by the autor: calculated], but that you get a score for the number of ideas, so some generate a lot of ideas, but that doesn't help overall. So you can call it an incentive problem." [P_f]

> "That's why I didn't give the leaderboards such a high rating, because I had to think about this classic forum thinking. ... we also had a forum and then there was always only a handful of top people and I found it always rather demotivating, because one only ever sees ... the few who score really well ... if that is perhaps a team, then I can imagine it ... difficult ... that one then so to speak 'drowns' and that then the own contribution is reduced to such a leaderboard" [P_a]

> "So comparing between teams, I actually think it's okay, but to compare myself, that generates kind of a pressure ... so it just creates competition in a case where I think you should work together. ... that you just collaborate less because you want to keep the ideas to yourself in order to get further up on the leaderboard" [P_b]

Participants were interested in getting feedback on team performance:

> "actually important is the team that you have, that it works well and this is my main motivation why I would participate and not to somehow know for myself what I am good at, because I think I already know that quite well" [P_f]

> "to see if the composition [of the team] is ok and what it is still lacking, in order to improve performance." [P_f]

> "Because if you want to participate on such a tool, one is interested in the overall result and therefore I am very interested in the results about others, whether I can help there somehow." [P_f]

However, visibility of individual strengths is not desired for other teams:

> "I wanted it so that ... members of other teams can't necessarily see which categories I'm good at. Not because I want to hide it, but because I just don't think they are interested in it." [P_d]

Allowing to contribute parts of an idea and giving recognition for individual contributions to an idea was considered promising:

> "I always enjoy it when things are connected with a score, that you can improve yourself [Annotation by the author: on that score]. I found this breakdown ... exciting, because I can then also find out for myself on

> the one hand perhaps what my strengths are, but on the other hand also, what we actually like doing. ... As I realized then that I'm not the one who posts the very first idea on there [Annotation by the author: on the platform] and completely wild and many [Annotation by the author: ideas], but rather like to think about what's behind the idea" [P_e]

> "So I would definitely like it, if somehow the names of those who have contributed were somehow listed in the idea and if you get a special badge, maybe when the idea is really implemented in the end or if you get a special recognition, that you somehow get a partial badge. I don't know how to put that into practice: 'Was involved in a top idea' or something like that" [P_h]

To summarize, badges were liked by participants, but there was no clear opinion on whether badges should be assigned automatically or whether they should be assigned by other people. Featuring ideas was also rated positively by participants, who considered it useful for themselves as an archive of ideas and useful in the interaction with others, to disclose what one is interested in and expert at, while also being able to infer that about other individuals or teams. Also, comparing the own performance to a previous period of time was assessed positively. Leaderboards, on the other hand, were were considered to have too much of a 'competitive' character, at least when the leaderboard was shown at the level of individual people (it was assessed more positively on a team level). Also on a more general level, while performance visibility was welcomed on a team level, participants were cautious with regards to the visibility of individual performance to others.

Consequently ten participants were invited to focus group interviews to gather deeper insights on task motivation and to get an indication on promising gamification elements.

## 4.3. Focus Group Interviews

I invited ten participants for focus group interviews, which I set up as two sessions of five participants each. All ten participants were students from different study backgrounds, all of them had already participated in brainstormings as well as structured ideation sessions in teams and had taken part in online ideation sessions.

The focus group interviews lasted 2.5 hours and were held in an experimental laboratory. Participants were first given fifteen minutes to participate in an online ideation session with the goal to generate ideas on how the Center for Digital Technology and Management (CDTM) — the institution they all had attended or were attending to reach an Honour's Degree in Technology Management — could live up to its vision 'To connect, educate & empower the innovators of tormorrow'. They were instructed on the various interaction possibilities they could perform on the platform and that the outcome would be presented to the management team of the CDTM, including the information who had contributed to an idea. Each participant was assigned a seat at a table with a PC and monitor. Separating walls ensured that participants would not see their neighbor's screen. Also, they were not allowed to speak. For participants not to be influenced by others, the session was not collaborative. Seven ideas, emulating previous entries by other participants, had been entered before the session and could be interacted with: Just like in the study in section 4.1, ideas could be voted on, built-upon, they could be extended (=adding or changing details) and they could be commented on. Participants could also choose to add their own ideas.

After the ideation session, participants were asked to fill a questionnaire on which tasks they had liked doing and which they had disliked. For successful innovation it is essential that different people collaborate on ideas [115], as the expert interviews in section 3.1 confirmed. In the questionnaire, I asked participants about their motivation for the various tasks of the ideation process that they could engage in. The tasks participants were asked about about are central tasks in a collaborative ideation process:

1. Detail out ideas
2. Generate 'wild', disruptive ideas
3. Formulate ideas for others to build upon
4. Comment on other people's ideas
5. Rate other people's ideas
6. Build upon others' ideas

The tasks *Generate 'wild', disruptive ideas*, *Formulate ideas for others to build upon*, and *Build upon others' ideas* were selected as they are part of Osborn's rules for

| Task | Part. 1 | Part. 2 | Part. 3 | Part. 4 | Part. 5 | Part. 6 | Part. 7 | Part. 8 | Part. 9 | Part. 10 | Mean | SD | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Detail out ideas | 3 | 5 | 3 | 1 | 4 | 5 | 1 | 5 | 5 | 5 | 3,70 | 1,64 | 4 |
| Generate "wild", disruptive ideas | 2 | 5 | 5 | 5 | 5 | 3 | 3 | 2 | 4 | 1 | 3,50 | 1,51 | 6 |
| Formulate ideas for others to build upon | 4 | 5 | 3 | 5 | 5 | 3 | 3 | 4 | 3 | 3 | 3,80 | 0,92 | 3 |
| Comment on other people's ideas | 4 | 3 | 3 | 3 | 3 | 5 | 5 | 4 | 1 | 5 | 3,60 | 1,26 | 5 |
| Rate other people's ideas | 5 | 3 | 5 | 5 | 4 | 3 | 5 | 3 | 2 | 5 | 4,00 | 1,15 | 2 |
| Build upon others' ideas | 4 | 5 | 5 | 3 | 5 | 3 | 5 | 4 |  | 3 | 4,11 | 0,93 | 1 |

**Figure 4.4.:** Motivations for the different tasks stated by the focus group participants; the color of the cells indicates participants' answers: dark green=5, light green=4, white=3,light red=2,dark red=1

brainstorming [88]. I added the tasks of detailing out ideas, as various expert interviews with innovation managers and innovation consultants in a supervised master thesis by Jann Speyer, alumnus of Business Studies at the Technical University Munich, revealed that lack of detail is an issue of today's ideation processes. Finally, the tasks of commenting and rating ideas were added as they are both necessary for enabling collaboration on ideas.

Participants were asked to indicate the probability with which they would perform the mentioned tasks, on a 5-point Likert Scale. The Likert scale ranged from 1 ="tasks I would not do" over 3 ="tasks I would do only if asked to do so" to 5 ="tasks I would do", with the ability to choose intermediate responses selecting scores 2 and 4. As one can see in Figure 4.4 task preferences among participants varied highly.

### Insight on Task Motivations

As Figure 4.4 shows, preferences of participants for the different tasks in a computer-supported ideation process were highly diverse. The focus group interviews allowed to ask participants for their reasons, and the following selected statements are reported to provide some further insights.

Some participants did enjoy generating ideas, while others did not consider themselves creative enough. The two positions are substantiated by exemplary quotes. The following quotes are from participants motivated to generate 'wild' ideas:

> "I liked most: *Generating wild ideas*, *Formulating ideas for others to build upon* and *Building upon others ideas*. So everything that is part of the process of idea generation and all this." [P01]

> "Task I would do. First: *Generate wild and disruptive ideas*. ... that means you are free to do whatever you want and you have the ability to explore. So I find that really interesting" [P02]

Participants not motivated to generate ('wild') ideas seem to lack 'creative confidence'. The following exemplary quotes from focus group participants suggest this.

> "I ... wouldn't be creative enough in general for wild ideas." [P03]

> "Task I would do if asked: *Generate wild ideas* and *Formulate ideas for other to build up on*. Because I would probably feel not creative enough. ... I wouldn't feel probably creative enough to volunteer to do that." [P01]

> "For me the task I would not do is *Generate wild disruptive ideas*. Like if someone tells me to ... come up with a wild idea I definitely cannot do that. I don't think I'm creative enough" [P04]

As mentioned before, lack of detail is often an issue in both in-person and online ideation processes. The following statements give insight into the thoughts of participants who did like to detail out ideas and others who did not, as both motivations were found among participants.
Participants who liked detailing out ideas stated:

> "What I would definitely do and I love to do is kind of detail out ideas. Because that's where I think my skills are ... Like taking an idea, explaining it and seeing how it can actually be implemented." [P04]

> "Tasks I would do is actually generating disruptive ideas but also bringing it to life also the phase of detailing it out. I would like to have a tool which guides me along this way of having a wild idea to really detailing it out and asking me for things that I need in order to detail it out. ... I like to see that they [annotation of the author: the ideas] turn into reality. So having this kind of action plan that you have everything necessary in order to put it into practice. So that is something which I really wanted to do." [P05]

Others did not like adding detail to ideas:

> "I would not do is a) *Detail out ideas*. I love to create ideas but I'm quite quickly bored so I'm always happy to throw out ideas and to not be the one to detail them out to the very end." [P01]

> "... *Detail out ideas* depends whether its mine or whether its not mine." [P06]

> "task I would not do is *detail out other people's ideas*. The reason is because as I said earlier that the originator usually has a vision when he starts an idea and if you don't have the vision then I think it's not easy to come up with a detailed idea. So that's why I would not do that." [P02]

Also for commenting on ideas and for rating ideas, there were both participants who were motivated for the task while others were not. Some exemplary comments are subsequently reported.

The following statements are from participants who were motivated to comment and evaluate ideas of others (and different reasons behind that).

> "would like to do *Rating other people's ideas*. Always interesting to see what other people think so I found this really interesting." [P02]

> "Because I'm ... lazy person ... rating is like really cool for me. Because writing texts like I'm super lazy." [P07]

> "*Rate other people's ideas* is just something that I can do because it's easy and fast." [P06]

> "I would quite happily comment, rate and build upon others. I always love to proofread things. I'm quite good there. I love to challenge." [P01]

> "So I was motivated to rate and comment on other people's ideas. Because I just find that easier and where I can contribute the most" [P10]

Statements from participants who were not motivated to comment and rate ideas included the following:

> "Task which I would not do or would I rather not do is probably like *Commenting on other people's ideas* and *Rating other people's ideas*. I think it is like more time consuming ... and I don't know what is happening with this information afterwards. " [P05]

> "Everything I enjoyed doing except maybe the commenting and rating... I feel I will have to be reminded to help someone. Like comment on their project." [P08]

> "what I least like is like *Comment on other ideas*" [P06]

**Ranking of Gamification Elements**

The participants then received an introduction to the gamification user types as defined by Marczweski [78]. They were handed out a list with the description of different gamification elements, associated with the six gamification user types [35, 78]. The participants were asked to mark the gamification elements that they considered to bear the potential to motivate participants in a computer-supported ideation process. I consequently counted the number of times each gamification element was marked as promising and ranked them (Figure 4.5).

| G. User Type | Element | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P10 | # | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Achiever | Challenges | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 9 | 1 |
| General | Progress/ Feedback | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 8 | 2 |
| Philanthropist | Sharing Knowledge | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 8 | 2 |
| Socialiser | Competition | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 7 | 4 |
| General | Time Pressure | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 6 | 5 |
| Disruptor | Anonymity | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 6 | 5 |
| General | On-boarding/ Tutorials | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 5 | 7 |
| Achiever | Levels/ Progression | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 5 | 7 |
| Disruptor | Voting/ Voice | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 5 | 7 |
| Player | Leaderboards/ Ladders | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 5 | 7 |
| General | Narrative/ Story | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 11 |
| General | Curiosity/ Mystery Box | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 4 | 11 |
| Schedules | Random Rewards | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 4 | 11 |
| Schedules | Fixed Reward Schedule | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 4 | 11 |
| Socialiser | Gildes/ Teams | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 4 | 11 |
| Socialiser | Social Network | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 11 |
| Socialiser | Social Discovery | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 11 |
| Free Spirit | Exploration | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 11 |
| Free Spirit | Customization | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 4 | 11 |
| Philanthropist | Meaning/ Purpose | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 4 | 11 |
| Player | Physical Rewards/ Prizes | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 4 | 11 |
| Disruptor | Innovation Platform | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 22 |
| Disruptor | Anarchy | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 22 |
| Player | Points/ Experience Points (XP) | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 3 | 22 |
| Player | Badges/ Achievement | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 22 |
| General | Signposting | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 26 |
| General | Theme | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 26 |
| Socialiser | Social Status | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 26 |
| Free Spirit | Branching Choices | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 26 |
| Free Spirit | Unlockable/ Rare Content | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 26 |
| Achiever | Certificates | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 26 |
| Achiever | Learning/ New Skills | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 26 |
| Achiever | Quests | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 26 |
| Achiever | Boss Battles | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 26 |
| Philanthropist | Care-taking | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 26 |
| Philanthropist | Collect & Trade | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 26 |
| Disruptor | Development Tools | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 26 |
| Player | Lottery/ Game of Chance | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 26 |
| Free Spirit | Easter Eggs | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 39 |
| Free Spirit | Creativity Tools | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 39 |
| Philanthropist | Access | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 39 |
| Philanthropist | Gifting/ Sharing | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 39 |
| Disruptor | Light Touch | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 39 |
| General | Loss Aversion | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |
| General | Scarcity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |
| Schedules | Time Dependent Rewards | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |
| Socialiser | Social Pressure | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |
| Player | Virtual Economy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |

**Figure 4.5.:** Gamification elements ranked by number of participants that marked them as particularly suitable to motivate engagement on online ideation platforms; the underlying gamification user type is given in column 1, participants' columns contain a 1 if the participant marked the element, a 0 if they did not; the last column is the rank based on the number of marks, which are given in the second last column

Analyzing the gamification user types for which the elements were recommended by Marczweski [78] (see column 1 in Figure 4.5), it can be noted that among the top ten selected elements (ranks 1 to 7), five of the six gamification user types are represented. This, in addition to the differing task motivations previously mentioned, suggests the need to further understand users, their needs and their task motivations. This leads over to the quantitative study in section 5, which analyzes user personalities and task motivations.

# 5. Increasing Engagement: Promising Approaches

In order to verify findings from the previous user studies, expert interviews and user interviews and in order to understand the different personalities which should be addressed [41], a quantitative study was conducted. The goal was to gain further insights into the personality of desired leads users of computer-supported collaborative ideation processes, and to understand their different task motivations within an online ideation process.

## 5.1. Study 3: Ideators' Drives and Task Motivations


| Veronika Gamper | Florian Kofler | Andreas Butz | Klaus Diepold |
|---|---|---|---|
| Technical University Munich | Technical University Munich | University of Munich | Technical University Munich |
| Germany | Germany | Germany | Germany |
| gamper@cdtm.de | florian.kofler@cdtm.de | butz@ifi.lmu.de | kldi@tum.de |



While we know that online idea management platforms can bring several advantages over face-to-face ideation meetings such as brainstorming sessions, they have not found wide acceptance yet. We quantitatively analyzed (N=146) values of desired lead users of online ideation processes based on the theory of Basic Human Values as well as their motivations for various tasks in offline and online ideation settings. By conducting a factor analysis, we identified six factors of task motivations. Comparing motivations in offline and online settings, we found that motivations in an online setting are considerably lower with regards to collaborative tasks. Practitioners and researchers can use our results to better understand the motivational gaps between offline and online settings, as well as the specific target group of lead users and their values. This provides a basis for further investigations on how to increase task motivation in online ideation settings.

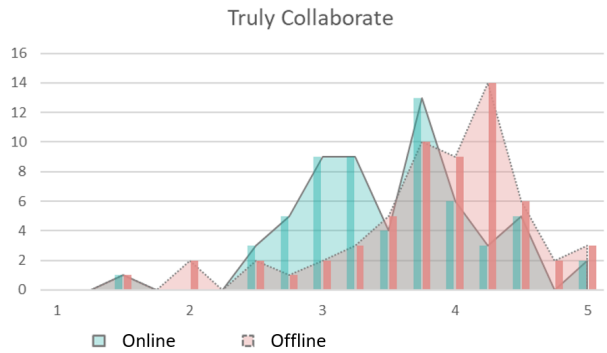



**Figure 5.1.:** The motivation for collaboration tasks regarding ideation is significantly lower in online than in offline settings; x-axis = motivation score, y-axis = number of participants.

### 5.1.1 Introduction

Facing intense global competition, organizations increasingly strive to be more innovative to build or retain a competitive advantage [125]. Despite an increasing uptake of enterprise social network solutions for ideation [7], and research findings supporting that electronic brainstorming can yield more ideas than verbal brainstorming [26] as well as counteracting some of the process losses of verbal brainstorming [36, 37, 66, 15], the latter is still more widely used in practice. Research suggests that one reason for the low acceptance of electronic brainstorming is the fact that users are not only interested in the quantity and quality of the output, but also in other factors, such as group well-being and member support [26].

Recent developments in innovation research ask to replace the traditional model of the single innovator by Schumpeter [106] by a more promising collaborative approach [115], e.g., showing that the output of ideation platforms improves if participants engage in a mix between competition and collaboration on the platform [14, 42]. Furthermore, research suggests that the implementation of software for collaborative innovation needs to be primarily concerned about the human [25, 43] and less about the technology. Of special interest are ‘innovators’, which we define as highly creative, entrepreneurially minded, innovation affine, and digitally skilled individuals, as they are the ones to be addressed for innovation tasks in the first place,both in-person and on online platforms.

Researchers highlight the need for more research on what influences participation and on recognition and rewarding mechanisms [6]. Leimeister et al. [75] state that for the desired behavior to occur, participants need to be activated through motives and incentives. Hence it is worth to investigate incentives and reward structures [1, 42, 105] as well as suitable interaction and feedback mechanisms [75, 1] of innovators as they are the relevant group to be attracted for the task [56]. Therefore, as individuals differ in their personalities [41] and these differences need to

be addressed to satisfy different users [83, 95, 9], we aim to contribute to a better understanding of how this may be accomplished with our study.

This study investigates the personality of 'innovators' — which we define as highly creative, entrepreneurially minded, innovation affine, and digitally skilled individuals — based on the well-acknowledged Theory of Basic Human Values [108, 110, 109]. We subsequently analyze their task motivations and identify six distinct motivational factors based on a factor analysis. The study then compares motivations between offline and online ideation settings for each of the six factors of task motivation.

#### Structure

The study report will unfold in three logical steps: (1) We present a quantitative analysis of personal values of innovators and their motivations with regards to ideation tasks in offline and online ideation settings. (2) We identify six factors of task motivation based on a factor analysis. (3) We consequently point out differences between offline and online motivation for each factor, which allows to identify improvement potential. This points towards interesting hypotheses for future work on motivation for collaborative ideation.

#### Research Questions

1. Q1 — Personal Values: How can innovators (being lead users for innovation platforms) be characterized based on their personal values?
2. Q2 — Task motivation and motivational factors: What tasks are innovators motivated for in offline and online settings and which motivational factors can be identified?
3. Q3 — Improvement Potential: What are the biggest gaps in motivation for ideation tasks comparing offline and online settings?

### 5.1.2 Related Work

With Q1 we aim to better understand innovators (highly creative, with an entprepreneurial mind, innovation-affine and digitally skilled individuals, as previously defined) as the main target group of ideation software platforms in a company setting [56]. They are also to be considered lead users with regards to innovation platforms, and can support the adoption of the platform by the larger mass of followers. As practical experiments suggest that lead-user methods can lead to promising new product ideas in an effective and systematic way [59, 77, 85, 118], lead users are crucial when it comes to technology adoption. Only if they are convinced of the product or service, others will follow. With the analysis of task motivations and

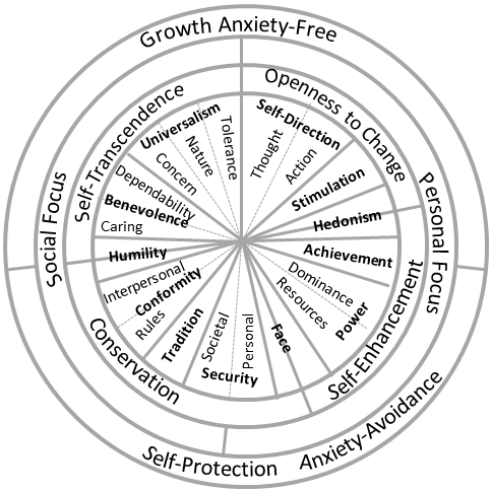



**Figure 5.2.:** Schwartz' et al. proposed a circular motivational continuum of 19 values, figure adapted from [109]

motivational clusters in Q2, we reduce the complexity to few, strongly related factors. The comparison between offline and online motivations with regards to the six factors in Q3 allows to identify larger motivational gaps and hence improvement potential. We believe that when there is a significantly higher motivation for tasks in an offline setting compared to an online setting, hence the general ability and motivation for a task being present, this may offer an opportunity for improving the motivation for the task also in an online setting. Below, we will elaborate on relevant related work and theoretical findings.

### Personal Values and Individual Differences

Individuals are different regarding their personality [41] . Because of these individual differences, the behavior of users differs from person to person. Applications that are intended for a broad range of people should therefore take these differences into account [83, 95]. Trying to apply one solution for everyone may lead to no one being really satisfied [9].

Schwartz' theory of basic human values [108, 110, 109] is considered a well proven approach to understanding differences between individuals based on their values. The theory has been validated across various studies in different cultures [26, 109]. In contrast to personality traits, such as the Big Five (openness, conscientiousness, extraversion, agreeableness, neuroticism) [24], which also can explain differences in behavior between individuals, personal values are less stable. They are defined as a number of beliefs or life principles that are influenced by the environment and develop over time [108, 86].

#### Task Motivation and Motivational Factors

Research on creativity intensified in the 1950's. Osborn [88] introduced the today well-known and widely employed creativity technique of brainstorming, in which members of a group meet in person and voice their ideas. He proposed four rules: (1) rule out criticism (2) welcome "free-wheeling" (3) go for quantity (4) seek combination and improvement. These rules are also applied to general idea generation, rule (1) is then referred to as "defer judgment" [88, 90]. While several process models for creativity have been proposed, e.g., [120, 4, 9, 91], we here adhere to Amabile's process model [4], which focuses on the phases that are usually found in corporate ideation settings, both offline and online, namely:

1. *Problem or Task Presentation*: A stimulus starting the process, can be internal or external
2. *Preparation*: Includes building or reactivating relevant information
3. *Response Generation*: Generating possible answers
4. *Response Validation*: Testing the possible answers against known facts or other criteria
5. *Outcome*: Evaluation of the outcome. If the goal was reached, the process ends, if no possible answers could be generated, the process failed and ends. If some progress was made, another iteration of the process is started.

### 5.1.3 Research Procedure

Our research comprised the following main steps: First, we gathered data by sending an online questionnaire that collected demographic information, personal values as defined by Schwartz et al. [109] and the motivation for certain ideation tasks. Based on the Theory of Basic Human Values [108, 110, 109], we then analyzed the personality of participants (see STEP 1). We consequently analyzed which tasks show significant differences between the general motivation for online and offline ideation settings for the individual tasks (STEP 2a). Consequently, we performed a factor analysis to reduce complexity and identified relevant motivational factors (STEP 2b). For each factor, we built a new motivation score and compared the differences both graphically and using t-tests (STEP 3).

#### Recruiting and Sample

We sent out an email to 782 alumni and active students of an interdisciplinary add-on study program on Technology Management, whose aim is to educate future innovators. With students from different study backgrounds, mainly from Computer

Science, Business Studies and Electrical Engineering, but also various other fields such as Psychology, Law or Medicine, the aim of the program is to teach students the tools and methods that enable them to plan, manage and implement innovative projects in the field of digital technology. The focus is on trend analysis, ideation, product development and entrepreneurship and most students later take on leading positions, be it in industry, startups, academia or founding their own startups. Our aim was to study innovators — independent of their background or field of work, as they would be the lead users of ideation platforms, which our choice of participants therefore closely matched. Out of 153 questionnaires that were completely filled, 146 participants also had correctly responded to a control question and hence formed the basis for our analyses. Out of the 146 participants of the study, 60 had also taken part in online ideation sessions and could hence give us insight on their behavior/motivation in online ideation tasks. Participants were on average 27 years old, the majority being male (74.4%), which represents the average male/female ratio in the student and alumni body of the study program (24.4% female, 75.6% male). The background of participants was mixed, with 75 participants having a technological study background, 55 having a business study background and 16 participants being from other study backgrounds. 110 out of 146 participants were from Germany, 36 came from other, mostly European, countries. All had been studying in Germany and had been living in the country for one or several years.

**Data Collection — Online Questionnaire**

Next to a set of demographic questions and the question whether participants had also taken part in an online ideation session (offline ideation sessions are part of the study program and hence everyone had experienced them), we included the following sections in our questionnaire: (1) The Personal Values Questionnaire according to Schwartz [109] and (2) a section on motivations for certain tasks in a) an offline ideation setting b) an online ideation setting. To assess the set of values of each participant, we took the 57 questions defined by Schwartz in his Portrait Value Questionnaire (PVQ) [109], which can be mapped onto 19 different values. Participants could rate on 57 items whether the person described in the question description is like them (from 1 = “not like me at all” to 6 = “very much like me”).

In the following part of the questionnaire, all participants were asked to report their motivation for offline and online ideation. “Offline” ideation experience was defined as ideation involving in-person meetings. Experience with “Online” ideation was defined as experience using an idea management system, as “a system that supports submitting, discussing, scoring and disseminating ideas, among other functions”[1]. We explicitly asked participants to refer to general ideation settings and to disregard any peculiarities of a specific ideation session or idea management tool. We

[1] The definition given to participants in the questionnaire

consequently identified 21 tasks of a typical ideation process, based on the phases of the creative process commonly found in corporate ideation settings, as defined by Amabile [4], namely *Problem or Task Presentation*, *Preparation*, *Response Generation*, *Response Validation*, and *Outcome*. We excluded phase 1) *Problem or Task Presentation*, which is usually externally given in offline and online ideation processes and focused on the latter phases. We listed tasks commonly occurring in these phases, both in offline and online settings. We intentionally included tasks that correspond to two rules of traditional brainstorming — as introduced by Osborn [31] — that encourage out-of-the-box thinking and building on ideas, i.e. the rules: a) *"free-wheeling" is welcomed* and b) *combination and improvement are sought*, as expert interviews suggested that these rules are often not followed. For all the tasks below, we found counterparts within an online ideation process:

- *Preparation*: explore data, do research on the topic
- *Response generation*: Generate incremental, feasible ideas; Generate wild, disruptive ideas; Detail out ideas; Build-upon others' ideas; Submit ideas that still need work; Collaborate on an idea as a team; Find solutions for critical issues of an idea; Make ideas more attractive; Make ideas more feasible; Formulate ideas for others to build upon; Generate ideas that will be scoring among the 'top' ideas; Mentioning people who might be able to solve a critical issue; 'Spicing up' ideas
- *Response validation*: Listen to other people's ideas (online equivalent: Read other people's ideas); Comment on other people's ideas; Identify benefits of an idea; Identify critical issues of an idea; Give suggestions how to improve ideas; Formulate quests on other people's ideas (=challenge them)
- *Output*: Rate other people's ideas

As the creative process is an iterative process, and — especially in an online context — people may join the process in different phases of the process, the phases may blur rather than be distinct from each other.

### 5.1.4 Analysis and Results

After collecting the data and excluding participants who had not correctly answered our test question, we started with our analysis.

#### STEP 1 — Analysis of Personal Values

We first evaluated the results from Schwartz' Portrait Value Questionnaire [109]. Figure 5.3 shows the mean values and standard deviations for the nineteen personal

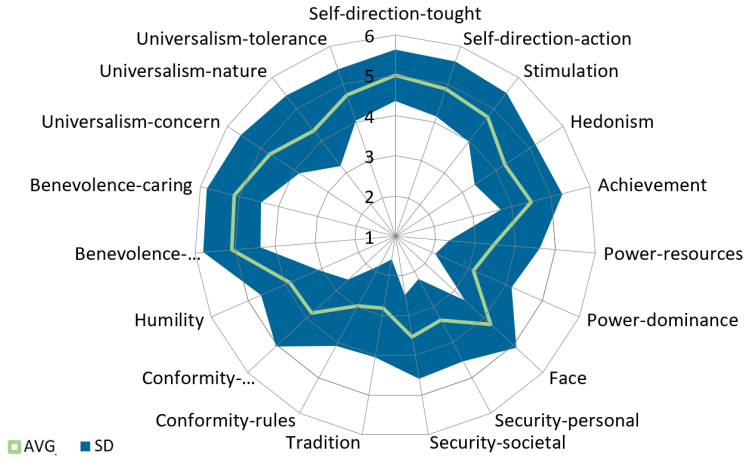



**Figure 5.3.:** Personal Values, mean (green line) and standard deviation (blue area)

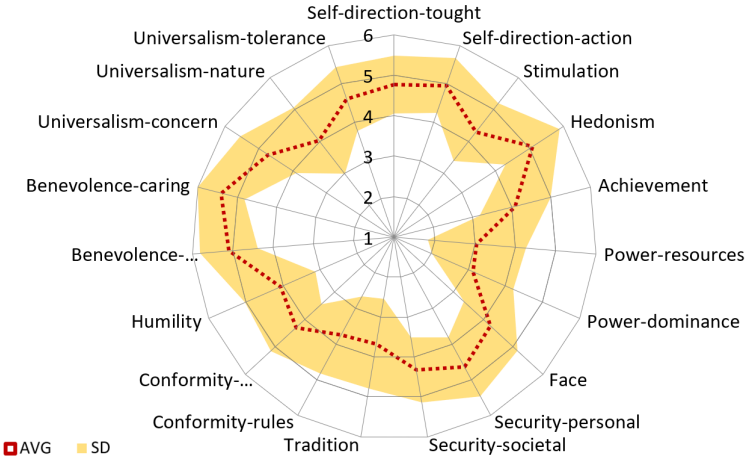



**Figure 5.4.:** Personal Values, mean (red dotted line) and standard deviation (yellow area) from Schwartz' study [109]

values of all participants. Figure 5.4 depicts the values of participants of the original study underlying the questionnaire [109]. While the values of *Self-direction* and *Achievement* as well as *Benevolence* and *universalism* (except for *Universalism-nature*) showed little deviation among the participants of our study, there was a high deviation with regards to *Tradition*, *Security*, *Conformity* and *Power* values, and also *Hedonism* and *Face* values deviated considerably. As the sometimes quite large standard deviation for certain values suggests, participants' values differed in several aspects.

Compared to the average scores of the underlying questionnaire [109], our group of participants scored visibly lower with regards to values *Security-personal* (M=3.37, SD=1.17 vs. M=4.64, SD=0.83), *Tradition* (M=2.82, SD=1.23 vs. M=3.67, SD=1.12), *Conformity-rules* (M=2.96, SD=1.13 vs. M=3.75, SD=1.08) and *Hedonism* (M=4.26, SD=0.91 vs. M=5.08, SD=0.80).

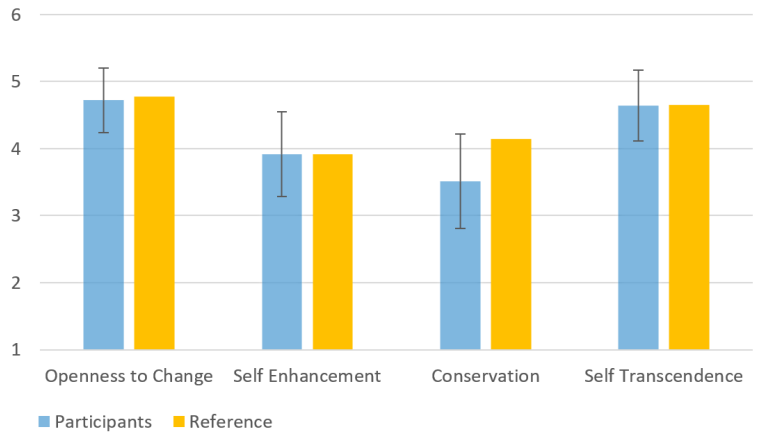



**Figure 5.5.:** Higher order value types *Openness to Change*, *Self Enhancement*, *Conservation* and *Self Transcendence*

Figure 5.5 and Figure 5.6 depict the scores obtained for the higher order value types, in comparison with mean values from the study by Schwartz et al. [109]. The mean of higher-order value types was computed by taking the average of the values associated with the respective higher-order value (for correspondence of values to higher order value types see Figure 5.2). This could not be computed for the standard deviation of the reference values.

As we can see from Figure 5.5 (and also from Figure 5.3 before), participants overall obtained high scores in values that represent *Openness to Change*, such as *Self-direction* (both *Self-direction action* and *Self-direction thought*), *Stimulation* and *Hedonism*, as well as regarding *Self-transcendence* (with the exception of *Humility*). Also with regards to the values that represent *Self Enhancement*, participants overall obtained high scores, while they had medium scores overall with regards to

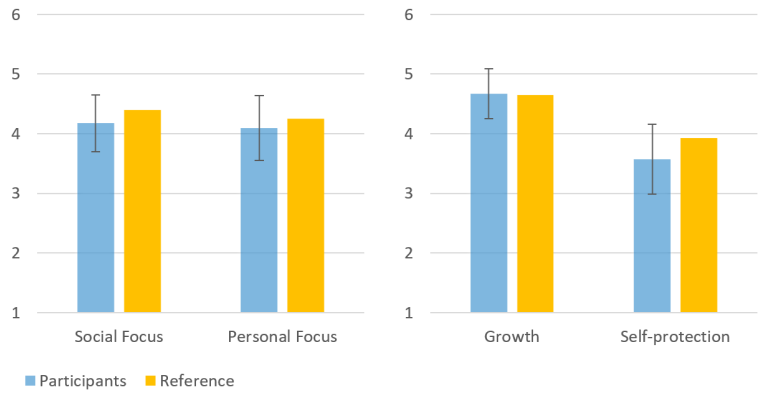



**Figure 5.6.:** Higher order value types *Social Focus* vs. *Personal Focus*, *Growth* vs. *Self-protection*

values of conservation. With regards to the mean values of the study underlying the questionnaire [109], we noted the largest difference with regards to the higher-order value *Conservation*, with our participants scoring lower, in addition to lower scores regarding *Self-protection* values (see Figure 5.6). There is no notable differences with regards to other higher-order values.

### STEP 2a — Analysis of Task Motivations

Participants were asked to indicate their motivation for the tasks in online and offline ideation settings on five-point Likert scales ("I like . . . " + task definition). Our further analysis on differences in motivation between the two settings is based on those 60 participants that had taken part in both offline and online ideation sessions.

Participants on average were more motivated to do a task in an offline setting than in an online setting for almost all tasks, except for rating, submitting ideas that still need work and formulating quests on other people's ideas (not significant). Wilcoxon signed rank tests on the differences between the offline and online task motivations show significant differences mainly for tasks involving the collaborative effort of participants: generate incremental ideas (Z=-2.183, p=0.029) comment on ideas (Z=-2.755, p=0.006), collaborate on ideas (Z=-3.935, p=0.000), make ideas more attractive (Z=-2.419, p=0.016), make ideas more feasible (Z=-2.042, p=0.041). Additionally, we found significant differences for the tasks to listen to others' ideas in offline ideation and, respectively, to read others' ideas in online ideation (Z=-2.287, p=0.022). As this is a prerequisite for collaboration, it deserves to be examined in detail.

```
## Loadings:
##          Factor1 Factor2 Factor3 Factor4 Factor5 Factor6
## OFM_Expl                                          0.75
## OFM_Geni                                          0.38
## OFM_Genw                  0.52
## OFM_Deta  0.30                           -0.50    0.31
## OFM_List          0.70
## OFM_Comm          0.69
## OFM_IdeB  0.48
## OFM_IdeC  0.62
## OFM_Find  1.00
## OFM_Coll          0.80
## OFM_Buil          0.44
## OFM_Subm -0.31                            0.46
## OFM_MakA                  0.33            0.39
## OFM_MakF  0.45
## OFM_ForI                                  0.67    0.39
## OFM_Give                          0.35
## OFM_Rate                          0.74
## OFM_ForQ                          0.74
## OFM_GenT                                  0.33
## OFM_Ment
## OFM_Spi                   1.02
```

**Figure 5.7.:** Loadings and resulting six factors

### STEP 2b — Identifying Motivational Factors

The 21 motivational measures showed some high correlations among them. In an effort to reduce the complexity and for identifying the underlying motivational factors we conducted a factor analysis (see Figure 5.7).

After evaluating mathematical approaches such as Eigenvalues, parallel analysis, optimal coordinates and acceleration factors, we propose the following six factors, which were identified using a maximum-likelihood factor analysis in combination with an oblique Promax rotation based on the offline data of the 146 participants, with a cutoff at 0.3 [63, 71, 116]. For a negative impact on the factor, we add the word "NOT" in front of the task name. Names were chosen in an effort to best describe our understanding of what they mean:

*Make viable*: Find solutions for critical issues of an idea, identify challenges of an idea, identify benefits of an idea, make ideas more feasible, detail out ideas, NOT submit ideas that still need work.

*Truly collaborate*: Collaborate on other people's ideas, listen to other people's ideas (online equivalent: Read other people's ideas ), comment on other people's ideas, build on other people's ideas.

*Be wild*: Spice up ideas, generate wild ideas, make ideas more attractive.

*Rate and steer*: Rate other people's ideas, formulate quests on other people's ideas (=challenge them), give suggestions how to improve others' ideas.

*Briskly contribute*: Formulate ideas for others to build upon, submit ideas that still

need work, make ideas more attractive, generate top-scoring ideas, NOT detail out ideas.
*Do the base work*: Explore data/do research, formulate ideas for others to build upon, generate incremental ideas, detail out ideas.

The actual factor scores were computed by using the non-weighted arithmetic mean of the motivational scores and negative motivations were taken into account by inverse coding of the Likert-Scaled items. We equally balanced the factor weights, as we calculated the online factors based on the weights derived from the factor analysis on the offline data.

### STEP 3 — Differences in Offline Vs. Online Motivation


**Figure 5.8.:** Participants' motivation scores for factors "Make viable", "Truly Collaborate", "Be wild", "Rate and Steer", "Briskly Contribute" and "Do the Base Work"; x-axis = motivation, y-axis = number of participants.

Figure 5.8 depicts the differences between the online and offline score distributions for the motivational factors. Paired samples t-tests show significant differences between offline and online motivations regarding the factors "Make viable" (t(59)=3.0278, p=0.00365), "Truly collaborate" (t(59)=4.1279, p=0.0001167), "Be wild" (t(59)=2.9116, p=0.005068) and "Do the base work" (t(59)=2.3551, p=0.02186). The differences for the first three factors also result significant regarding Bonferroni correction.

As observable in Figure 5.8, differences are visually noticeable especially with regards to the first three factors. We note that the largest gap between offline and online motivations with regards to factor "Truly collaborate", i.e. tasks relating to true collaboration on ideas. Additional differences can be noted with regards to factors "Make viable" and "Be wild". In both cases, there is a notable shift to lower motivation scores in the online setting. As we can see from Figure 5.8, with regards to the motivation for "Make viable", there is a higher number of people who rated their online motivation as very low to low (1-2), while we see a larger proportion of participants with higher motivation in an offline setting. Also with regards to "Be wild" the motivation to do so offline is higher than the motivation to do so online. For factor "Rate and steer", motivation is highly similar between both conditions. Also motivation for "Briskly contribute" is quite similar in both settings, with a slightly higher spread in the offline setting. The motivation for the factor "Do the base work" is somewhat higher in an offline setting.

In sum, the discrepancies between offline and online motivations are notable with regards to the factors "Truly collaborate" and "Be wild" and somewhat notable with regards to "Make viable". T-tests confirm that these differences are statistically significant.

### 5.1.5 Summary and Discussion

While software for collaborative ideation is a promising alternative to offline, in-person, ideation such as brainstorming, we still need to better understand the human factor of its users [25, 43]. In this process "innovators" are of special interest, as they are the main target group [56], and represent lead users within corporate ideation settings. To account for individual differences [41] and satisfy different users [83, 95, 9], we aimed to generate a more thorough understanding of their personalities, motivations and thereby identify promising avenues for further research on motivation for certain ideation tasks.

In our analysis, we found participants to score high on higher-order values *Openness to Change*, comprising values such as *Self-direction* and *Stimulation*. Also with regards to *Self-Transcendence* (comprising *Benevolence* and *Universalism* values), values were high and showed little divergence. Other values were more varied. In comparison to the study underlying the questionnaire on the 19 basic human values, our participants scored lower on *Conservation* values and *Self-protection*

values. The scores reflect our expectations of the participants, who represent high achievers with strong entrepreneurial spirit and high willingness to take things into their own hands, hence not shying risks and questioning rules imposed by society.

Participants seem to get more motivation to engage in collaborative ideation in face-to-face settings rather than online. This might e.g. be because they can expect reciprocity from people in a real-life setting, but they can less expect it in the usually more anonymous online setting. It has been found that reciprocity is a major driver for supportive relationships in face-to-face settings [97, 113], however not in online settings [121]. Also, the expectation of social rewards such as status and reputation has been found to induce individuals to engage in social interaction [15, 65]. Building a reputation is also a major driver to engage in online knowledge exchange [121]. The expectation of reciprocity and the chance to build a reputation may be strong factors for motivation in face-to-face settings that do not (yet) have equivalent counterparts online.

As people are motivated for certain tasks in an offline setting, but are less motivated for the same tasks in an online setting, we hypothesized a potential for improvement: Online ideation platforms could be improved so as to better address people who would be motivated for a task in an offline setting, but are not motivated for the same task online.

Our main contribution is the identification of six factors with regards to task motivation in ideation processes, their interpretation and the consequent comparison of task motivations between offline and online settings: “Make Viable”, “Truly Collaborate”, “Be wild”, “Rate and Steer”, “Briskly Contribute” and “Do the Base Work”. Our results suggest that especially with regards to true collaboration on ideas there is a large gap in motivation between offline and online settings. Similarly, online motivation is lagging offline motivation with regards to generating wild ideas and making other people’s ideas more attractive. The same is true for tasks on making ideas more viable.

Collaborative approaches to ideation seem more promising than approaches relying on single innovators [115]. Furthermore, rules for divergent thinking [88, 90] specifically ask for “free-wheeling” (i.e. “wild” ideas) as well as for the combination and improvement of ideas. Hence, the identified gaps in online motivation with regards to offline motivation for factors “Truly collaborate”, “Be wild” and “Make Viable” are highly relevant to address and study further. As Füller [48] pointed out, in online innovation communities there are different user types, and the sub-segment of participants that contributes to ideas by commenting (constructively or merely socializing) constitutes an important pillar of a lively online community. Therefore, it is highly relevant to try and onboard as well as retain people who may be valuable collaborators on ideas, even if they do not initiate ideas on their own.

Practitioners and researchers may find our results useful for pursuing two avenues for further study: On the one hand, there may be certain tasks within an ideation process that should continue to be carried out in an offline setting in order to have

people motivated for that task. In that case, it may be useful to mix both offline and online phases in an ideation process. Another promising avenue for further study is to address people who are motivated for a task in an offline setting but are less motivated for the same task in an online setting, by improving the online ideation process so as to better address their needs: Our insight on innovators' values may be useful for motivational design to entice knowledge sharing and interaction in online ideation settings, e.g. by designing the right kind of social rewards, such as status and reputation [121]. Knowing which values need to be addressed may help choose the most suitable motivational or gamification elements, and thereby reward currently neglected tasks.

### 5.1.6 Limitations and Further Work

We decided to use the entire group of 146 participants as the base for our analysis of overall personal values and as the base for the factor analysis, as it was our intention to study values and motivations of the entire potential target group of innovators, instead of targeting only those who had also participated in online ideation sessions (the participation in which was often coincidental e.g., due to course requirements). For comparing offline and online motivations we then focused on the 60 participants that had experienced both types of ideation sessions. The initial analysis of innovators' values and the factor analysis could also have been performed with only these 60 participants that had experience in both types of sessions, leading to somewhat less significant results, but would have neglected the analysis of participants who merely had not yet been given the opportunity to join online ideation sessions.

Our group of participants was rather young, and had just entered or was just about to enter their professional career after university. While it is an asset of our study, that the participants had different study backgrounds and were admitted to a highly selective entrepreneurial add-on study program that focuses on digital innovation, which qualifies them as main target groups of innovation activities in companies, this also means that it is not representative for the entire workforce of a company.

The scope of our study was to better understand innovators' personalities and point out differences in motivation between offline and online settings. Theoretically grounded in the well-established Theory of Basic Human Values, this may however not account for additional factors influencing motivation for ideation tasks that were not within the scope of the study, such as an individual's expertise in the domain or the specific social environment.

### 5.1.7 Conclusion

Our study aimed to characterize highly creative, innovation-affine, entrepreneurially minded and digitally skilled individuals ('innovators') based on their values as they are the lead users with regards to online ideation platforms in corporate settings.

We aimed to analyze their task motivations in offline and online ideation settings and to identify avenues to increse their engagement. We found their motivations for ideation tasks to be highly diverging between an offline and an online setting, with the motivation for the latter being considerably lower. This was especially true for tasks involving true collaboration on ideas, working on wild ideas and making ideas viable — all highly relevant elements of a successful ideation process. The identified differences between task motivations in online and offline settings and the elaboration on personal values of innovators serves as an interesting base, to both researchers and practitioners, for building and testing hypotheses on closing the gap between online and offline motivation in ideation processes.

# 6. Discussion

This chapter concludes the work presented in this dissertation. It reviews the research questions, summarizes the answers provided in the various studies and gives an overview of avenues for further research.

The goal of this dissertation was to find answers as to how to improve the engagement of users within collaborative, online ideation processes. For this purpose, I applied a broad mix of methods, from qualitative interviews with experts on one side and interviews with users on the other side, over focus groups, mixed-method user studies to a quantitative analysis of personal values and task motivations applying an exploratory factor analysis. The studies build upon each other and follow the structure depicted in Figure 1.2 in section 1.3.

The first research question deals with how offline and online ideation processes differ, which could provide interesting starting points for investigating why in-person (offline) ideation processes are still preferred over online ideation processes. I used the initial overview on relevant literature (section 2) and the insights from experts (section 3.1), as basis to form hypotheses on the improvement potential of computer-supported ideation processes. In essence, both literature and insights from experts suggest that while computer-support of ideation processes seems to have several advantages over traditional, in-person ideation processes, e.g. allowing to bridge geographic and departmental distances. However, there are still preconceptions and disadvantages to be addressed to increase acceptance. These findings led to the user study in section 3.2: An experiment contrasting a paper-based and a computer-supported, structured ideation process underlined the potential of software to improve process-support and eliminate known issues in traditonal brainstorming processes, such as fear of evaluation, production blocking or free-riding. It also identified areas for improvement of online ideation processes with regards to facilitating communication and improving group well-being.

From literature research and expert interviews, gamification emerged as a promising approach to increase user engagement and to steer user behavior. The studies underlined the need to differentiate among users, because of different approaches to creativity, personality differences and the different impact motivational and gamification elements may have on them.

The second research question deals with performance feedback as the backbone of most gamification elements, and how it should ideally be delivered in an ideation context. I analyzed various aspects of feedback (timing, content and visibility) in a user study (section 4.1) and in user interviews with participants who had participated

in online ideation sessions (section 4.2). The results suggest that the timing of feedback should be adapted to the perceived level of motivation and ability of participants concerning the task. With regards to content and visibility of performance feedback, interviews suggest it requires careful consideration of participants' preconceptions, and of the collaborative or competitive nature of the process. It is also advisable to limit feedback that is visible to other participants on team-level performance, while feedback on individual performance can be disclosed to the respective participants themselves.

Focus group interviews pointed towards large differences in task motivation from person to person (section 4.3). A ranking of promising gamification elements suggested that the highest-ranked gamification elements are associated with a mix of different basic user types and hence point towards a need to differentiate among participants. Both findings — the differences in task motivations and the mix of underlying user needs among the highest-ranked gamification elements — led to the subsequent analysis of lead users' personal values and task motivations.

The third research question asks how different users could be motivated to engage and, especially, to collaborate on ideation platforms. A quantitative analysis concludes this dissertation elaborated on innovators' personal values and their task motivations (section 5). According to the study, innovators score high on higher-order values *Openness to Change*, *Self-Transcendence*, and *Growth*, while scoring low on *Conservation*. An exploratory factor analysis led to the identification of six factors for task motivation. These motivational factors were compared with regards to online and offline task motivation, and three out of the six motivational factors show significant gaps in motivation, with online task motivation considerably lagging behind offline motivation. The largest gap is found with regards to collaborative tasks. Additional gaps are found with regards to generating 'wild' or out-of-the-box ideas and making ideas viable, e.g. by detailing out ideas. Tasks relating to these three motivational factors are consequently the tasks that are promising starting points for motivational design.

The guiding research question on how we can increase engagement in computer-supported, collaborative ideation processes can be answered by summarizing the various findings of the studies in this dissertation: Online ideation processes can counteract drawbacks of traditional, in-person ideation processes, but they still need to improve with regards to two aspects: 1) To facilitate communication, in order to allow for clarifying questions and to allow for building-upon the ideas of others, and 2) to improve group-well being, e.g. by fostering a team-feeling. Gamification is a promising approach that can help accomplish the latter and that can generally increase user engagement on online ideation platforms. It needs to be carefully drafted, to account for the differences among users. The timing, choice and transparency of the chosen feedback elements should be adapted to the users' various personalities, creative approaches, varying levels of knowledge and creativity as well as different task motivations. The motivational design should address the val-

ues of innovators — *Openness to Change*, *Self-Transcendence*, and *Growth* — and should focus on motivating tasks that bear the highest potential to improve: Tasks related to collaboration, to generating 'wild' ideas and to making ideas viable.

**Further Studies**

There are several promising avenues for further research that can be deduced from the studies presented in this dissertation.

First of all, study 1 (section 3.2) suggests that software-support in more complex group creativity processes can be advantageous compared to traditional, in-person processes. Since the group of participants was relatively small, a larger quantitative study may verify the hypothesis that resulted from the study. Furthermore, preconceptions on software-based processes may be interesting to investigate, as they may show gaps to the actual experience. The content of these preconceptions may consequently be addressed and their influence may be studied. This may be highly useful for practitioners in order to position their software offerings. Also, the main drawbacks of software-support, such as the difficulty in clarifying questions, missing incentives to build upon ideas of others, and the lower sense of group belonging, are important areas of investigation, addressed in the further studies of this dissertation.

The second study (section 4.1) suggests that an immediate feedback mechanism could both inspire and motivate participants, but that this may apply only to participants who deem themselves less motivated or less able than average. As the participants were students selected for their high interest in entrepreneurship and innovation, it would be interesting to repeat the study with a larger and more heterogeneous group of participants. Also, studying the actual motivation instead of the participants' self-perceived motivation and ability, might be an interesting addition to the study.

The third study analyzes the personal values of desired lead users of computer-supported ideation processes and consequently identifies six factors for task motivations, of which three show significantly lower motivation in online settings. This suggests to start with the respective task types as primary targets for improving motivation. A highly interesting path for further investigation is to address the desired lead users' values specifically in the context of these three task types, e.g. by selecting suitable gamification elements.

# 7. Conclusion

Although computer-support of ideation processes is highly relevant, especially with regards to an increasing global distribution of knowledge and experts, ideation in companies is still largely done in traditional, in-person brainstorming sessions or left to chance. To gain larger acceptance and further distribution for computer-supported ideation processes, several real or perceived drawbacks with regards to traditional, in-person ideation still need to be addressed. The needs of users of ideation processes should be identified and catered for in order to increase engagement. This would lead to a higher number and — through collaboration — potentially a higher quality of ideas, certainly increasing the chances of success. The improved management support would then in turn increase user engagement.

The experiments and analyses I present in this dissertation are a step towards better understanding the current drawbacks of computer-supported ideation processes and a step towards an understanding of the underlying users' needs. I consequently point out potential approaches in motivational design to address these needs.

I start the dissertation with an overview on extant knowledge on obstacles in traditional, in-person idea generation processes and how the use of software could act as a remedy. Consequently, I report further insights from experts in the field of innovation management, creativity and gamification, which shaped the studies in this dissertation, that helped answer the overarching resarch question on how to increase user engagement in computer-supported ideation processes.

The qualitative and quantitative user studies in this dissertation show a large motivational gap especially with regards to collaborative tasks in an online setting: Participants that would be motivated to collaborate in an offline setting were considerably less motivated to collaborate in an online setting. Gamification bears the potential to increase user engagement and to steer certain user behavior that is relevant in an ideation context, such as the just mentioned collaborative tasks. As gamification is largely based on performance feedback, the latter warrants further investigation. Therefore I analyzed the aspects timing, content and visibility of performance feedback. The analyses on the timing of feedback led to the conclusion that it should be adapted to the perceived level of ability and motivation of users. With regards to content and visibility of feedback, performance feedback on an individual level generally is preferred for the user about him- or herself, while it should only be presented on a team-level to others.

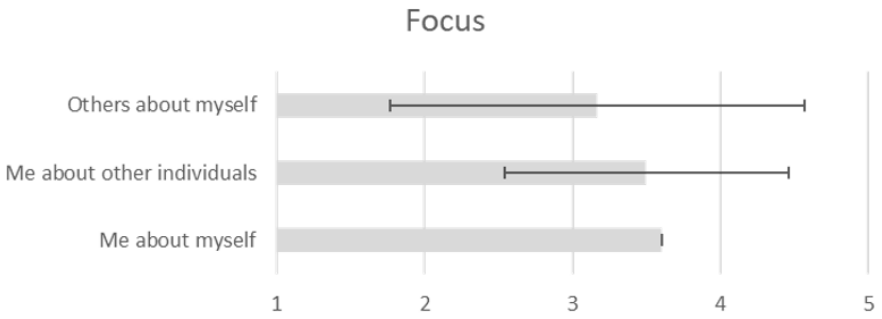
The analysis of task motivations in online and offline settings led to the formulation of six distinct motivational factors. The comparison between the motivation in online

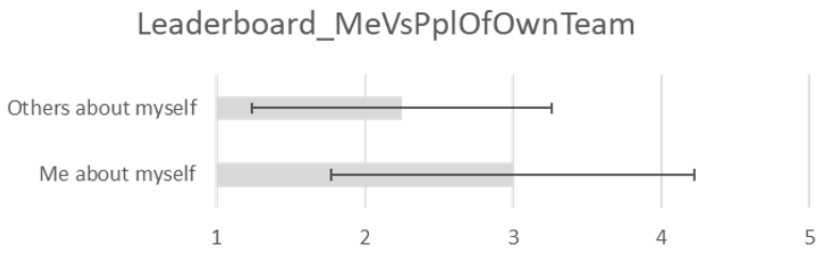
and offline settings suggests significant motivational gaps in online settings, especially with regards to: 1) collaborative tasks, 2) being 'wild', or generating out-of-the box ideas, and 3) making ideas viable. Tasks related to these three motivational factors are hence a promising target for motivational design, which should take into account the identified values of innovators as desired lead users of online ideation platforms.

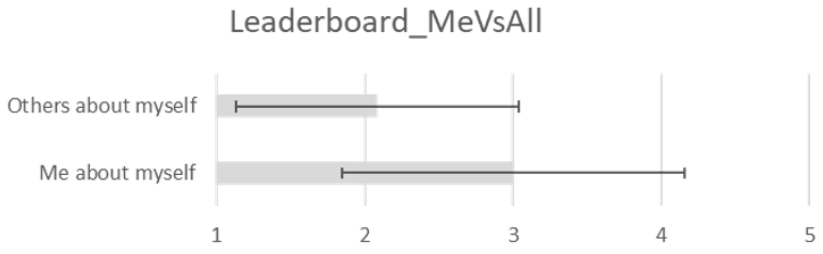
The dissertation presents valuable results for both practitioners and researchers: The propositions can act as a guideline in designing systems that address users' needs and — most importantly — they generate an understanding that one needs to differentiate among different types of users. The analysis of their personalities and task motivations can help to shape solutions that integrate a diverse set of users — a fundamental requirement for successful collaborative ideation.

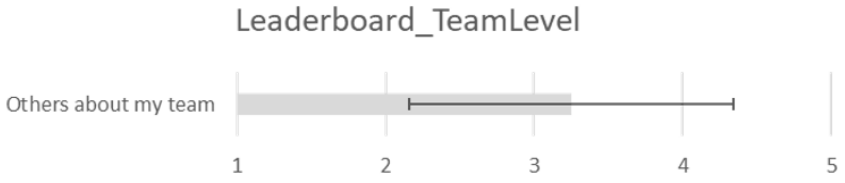
# A. Appendix

In this appendix, participants preferences for the various gamification elements across all visibility levels are depicted, as referenced in section 4.2. Furthermore, a note on my contribution to the studies with several authors is appended.

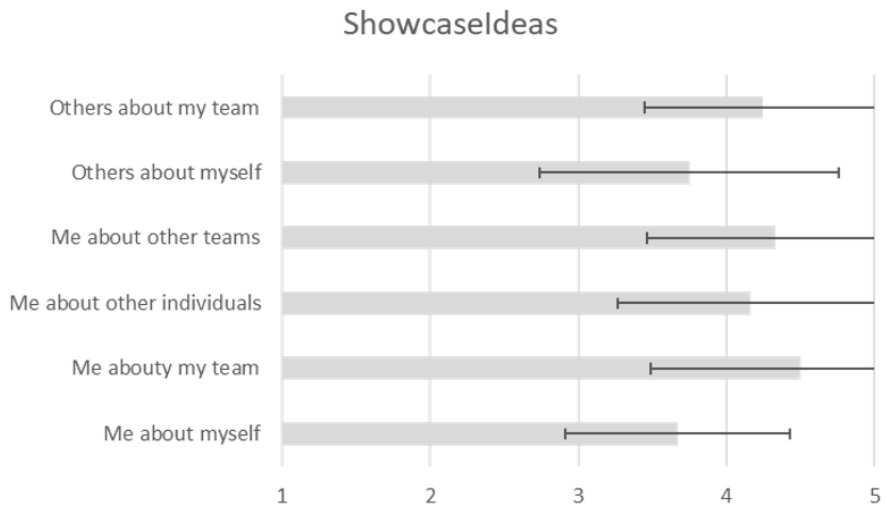


*A. Appendix*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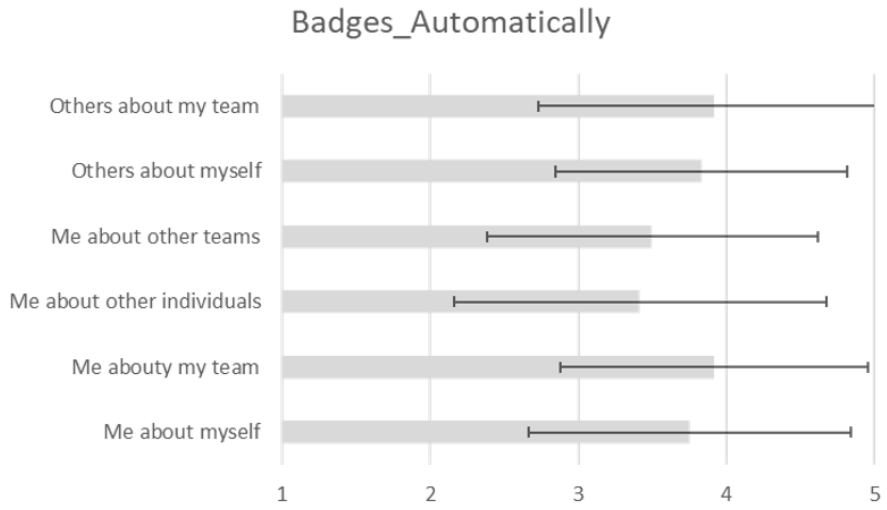
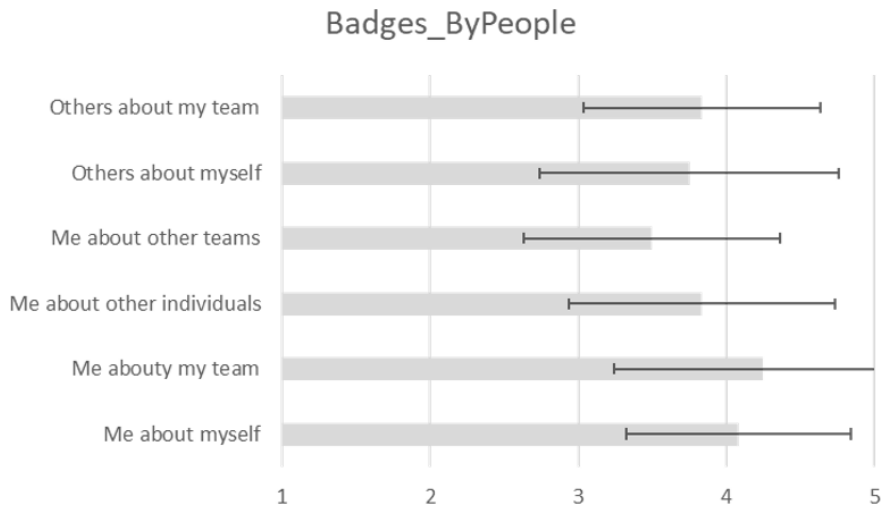
Others about my team
Others about myself
Me about other teams
Me about other individuals
Me abouty my team
Me about myself
1
2
3
4
5


Badges_Automatically
Others about my team
Others about myself
Me about other teams
Me about other individuals
Me abouty my team
Me about myself
1
2
3
4
5


Badges_ByPeople
Others about my team
Others about myself
Me about other teams
Me about other individuals
Me abouty my team
Me about myself
1
2
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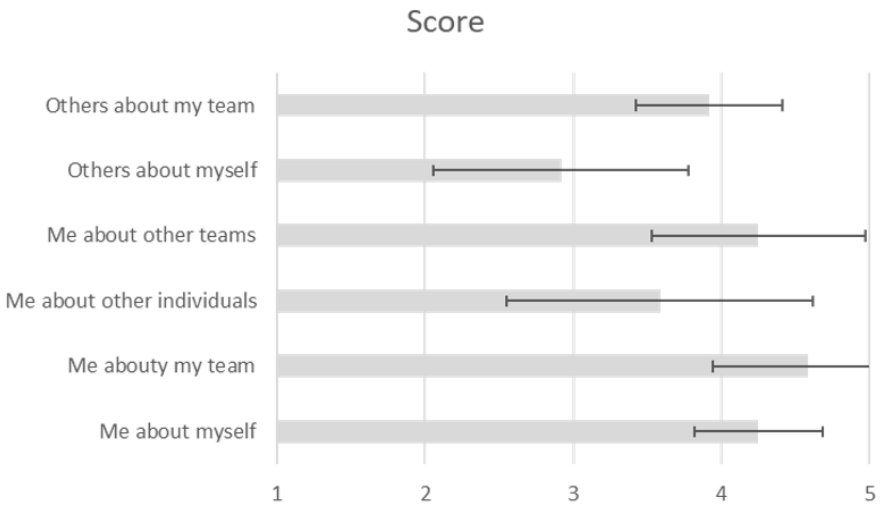
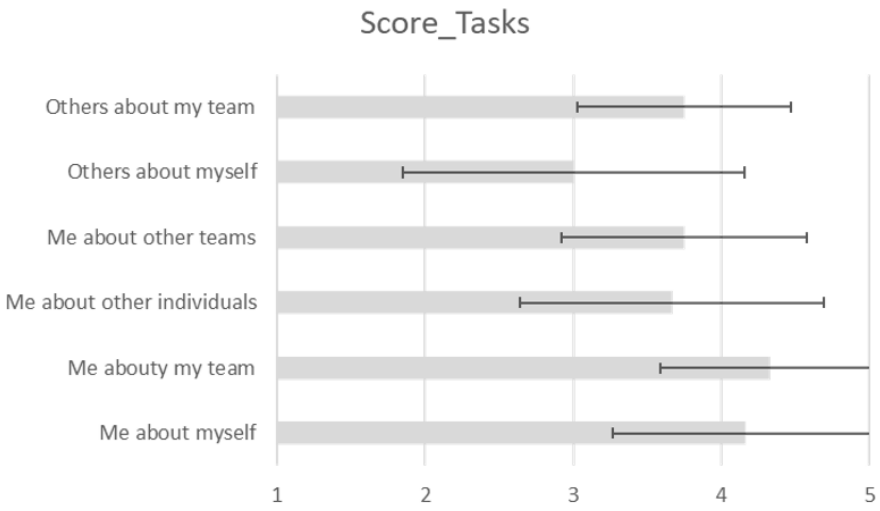
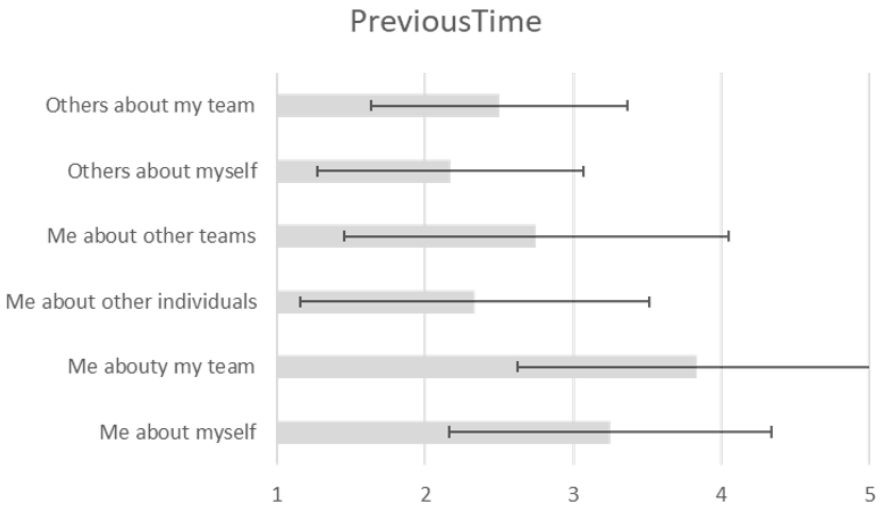
4
5


Score
Others about my team
Others about myself
Me about other teams
Me about other individuals
Me abouty my team
Me about myself
1
2
3
4
5


Score_Tasks
Others about my team
Others about myself
Me about other teams
Me about other individuals
Me abouty my team
Me about myself
1
2
3
4
5


PreviousTime
Others about my team
Others about myself
Me about other teams
Me about other individuals
Me abouty my team
Me about myself
1
2
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### Note on the Interviews

The interviews were held either in English or in German, depending on the language the interview partner felt more comfortable with. In this dissertation, the interviews are reported in English. If held in German, they were translated by the author. The interviews were all transcribed by a professional transcription service. The transcribed interviews are not reported in their entirety. They can be requested from the author, to be provided under reserve of compliance to data protection regulations.

### Note on Contribution

For the three studies reported in this dissertation that have several authors, the contribution shall be explained in the following paragraphs.

I, the author of this dissertation, am the first and main author of the studies. I defined the hypotheses, planned and conducted the studies, analyzed and interpreted the research results and wrote the discussion and conclusion. In study 1 (section 3.2), the second author Marin Zec contributed his knowledge in the field of creativity support software, especially for the introduction and the theoretical background. He also supported the clustering and analysis of the participants' quotes. The paper certainly benefitted from his experience in writing scientific papers. Stefan Langer built the prototype that served as a basis for the study within his master thesis, which I supervised.

In study 3 (section 5), the second author Florian Kofler helped with the statistical analysis of the results. With his background in statistics, he suggested several methods, while the decision on the method was then taken and the calculations performed jointly. The interpretation of the results was mostly my part. The Statistisches Beratungslabor (StaBLab) of the Ludwig-Maximilians-Universität München supported the analysis with consultancy services on the best statistical approaches to use for the specific use case in this study.

On all three studies, Prof. Butz and Prof. Diepold gave regular feedback and helped to shape the final paper. They provided feedback on the current status of the analyses, asked guiding questions and finally reviewing them for a conference-ready submission.

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