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Moments of (De)Valuation.
Confirmation and Devaluation of Ideas in Creative Processes

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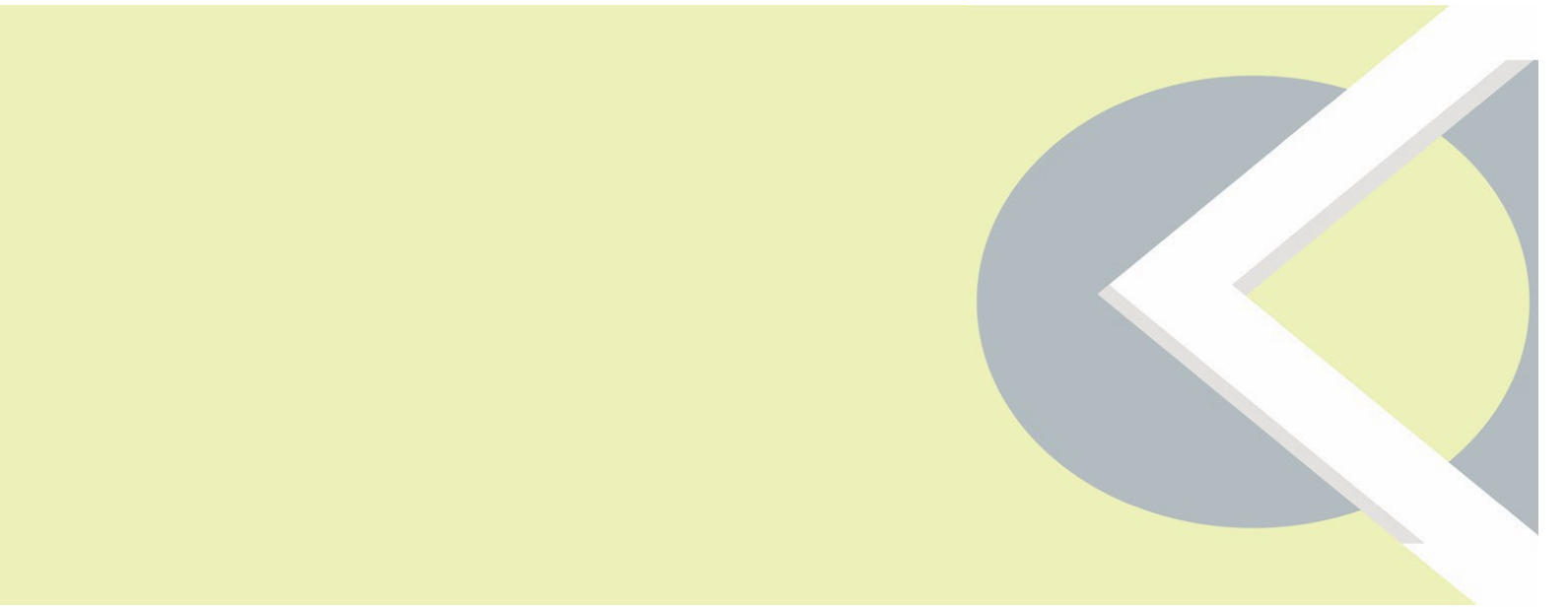

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About the Author

Alice Melchior is member of the DFG Research Unit "Organized Creativity" (FOR 2161) and doctoral student at the HafenCity University Hamburg, Germany
Contact: alice.melchior@hcu-hamburg.de
https://www.hcu-hamburg.de/professorinnen/stadtplanung/gernot-grabher/people/alice-melchior/

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Contact
Freie Universität Berlin, Department of Management
Prof. Dr. Jörg Sydow
Boltzmannstr. 20 (Raum 225)
14195 Berlin
Tel: +49 (030) 838-53783
http://www.wiwiss.fu-berlin.de/forschung/organized-creativity

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Abstract

In recent years contexts for fostering creativity were and still are a chief aim in the field of economic geography. Despite the sophisticated examination of the time-spatial constellation for fostering creativity in clusters, in projects or at events, economic geography concentrated mainly on the aspect of generating new ideas. In general, creativity does not only include the aspect of generation but also the aspect of valuation. However, the problematic of valuating ideas has so far been neglected in economic geography. In order to explore the relation between generation and valuation of new ideas within creative processes this paper seeks to push beyond the prevailing focus in economic geography and analyze the question to what extend the generation and valuation of new ideas are influencing each other. For this purpose, a process perspective on creativity and a pragmatic view on valuation are chosen. Accordingly, creativity is understood as a collective process, while valuation is characterized by multiple valuation criteria and situations of value uncertainty. Using the example of pharmaceutical

R&D projects to explore the relation between generation and valuation of new ideas within a creative process, this paper introduces an example of a scientific-analytic creative process. Based on the empirical data, it is shown that the relation between generation and valuation of new ideas within pharmaceutical R&D projects can be understood as a loop of mutual influence, where moments of valuation are crucial for the creative process. Furthermore, it is shown that particularly negative value judgements are essential for the generation aspect of creativity and that positive value judgements lead to path dependencies.

Keywords: creativity, valuation, moments of valuation, pharmaceutical R&D projects

Introduction

In the field of economic geography, primary spatial concerns for the generation of creativity have been at the very center of the research agenda for decades. The spatial aspect of generating creativity currently extended by a temporal aspect were comprehensively investigated in different time-spatial configurations such as clusters (Bathelt et al., 2004), as an example for long-term constellations, to medium-term constellations like projects (Grabher, 2004) up to short-term constellations such as events (Bathelt and Schuldt, 2008) or conferences (Maskell et al., 2006). Creativity, however, is understood in general as the generation of a novel and valuable contribution to a particular domain (Amabile, 1996; Csikszentmihalyi, 1997; Hautala and Ibert, 2018). Therefore, creativity includes not only the aspect of generating new ideas but also the aspect of valuating new ideas. Hence, new ideas must be generated *and* valuated within a creative process. And yet, the relation between generation and valuation of new ideas within a creative process has rarely been examined in a systematic fashion. On the one hand most studies in economic geography (and parts of organizational science, e.g.) were overly focused on the generation aspect of creativity and neglect the fact that creativity must also be ascribed (Grabher, 2018). On the other hand, there is a rich strand of research on valuation (e.g. in economic sociology) which rarely studied the generation aspect of creativity.

The importance of valuation in today's society and the grown importance of the question "what is valuable?" can be shown by the increased and quite diverse research about valuation

processes in the economy (e.g. Aspers and Beckert, 2011; Beckert, 2011; Beckert and Musselin 2013; Vatin, 2013; Alexius and Hallström, 2014) or the studies on valuation of "singularities" (Karpik, 2011: 20f) such as wine (Hennion, 2015), luxury perfumes (Trébuchet-Breitwiller, 2015) or the first electronic sound by a synthesizer (Pinch, 2015) as well as the "success of rankings as a social form" (Esposito and Stark, 2019: 13). Furthermore, the increased research interest on valuation can be highlighted by the founding of an independent, emerging and transdisciplinary field of Valuation Studies and the new foundation of a journal with the same name in 2013 (Valuation Studies, n.d.). Value, however, is not an inherent property of individuals or artefacts (e.g. Simmel, [1900] 2003), but must rather be socially constructed through negotiation processes between social actors (Hutter and Stark, 2015; Kraemer and Brugger, 2017).

In order to explore the relation between generation and valuation of new ideas within creative processes this paper examines the question to what extend the generation and valuation of new ideas are influencing each other within a creative process. In addition, the paper introduces an empirical example of a scientific-analytical creative process by analyzing the generation and valuation of new ideas within pharmaceutical R&D projects. Pharmaceutical R&D projects were chosen as concrete objects for the empirical analysis because they are an integral part of the most research-intensive industries in Germany (EFI, 2018) and therefore a viable starting point to analyze the generation aspect. Furthermore, the problem of valuating an idea in the pharmaceutical R&D has strongly increased in recent years due to the opening towards external knowledge sources by public-private and industry-academic partnerships (e.g. Khanna, 2012). In addition, pharmaceutical companies extended their search horizon for new and potentially valuable ideas by initiatives like crowd sourcing and open innovation platforms (e.g. Khanna, 2012). Hence, the possibility of multiple valuation criteria within pharmaceutical R&D projects increased and the actors are confronted with an accumulatively complex situation of valuating new ideas. And to make the valuation of new ideas even more complex, it is very characteristic for pharmaceutical R&D projects that several positive value judgements are still no guarantee that the idea will work out at the end of the creative process (e.g. p-16.08.03aiRE).

Due to the research interest, two perspectives are chosen to develop a detailed understanding of the relation between generation and valuation of new ideas within creative processes: In a first step a process perspective on creativity (e.g. Hargadon and Bechky, 2006; Ibert and

Müller, 2015; Garud et al., 2016; Perry-Smith and Mannucci, 2017) which assumes that the creative process is a collective "journey in-the-making" (Garud et al., 2016: 456) and can be subdivided into several contexts is used to explore the influence of varying contexts within the creative process on the generation and valuation of new ideas. Second, a pragmatic perspective on valuation (e.g. Dewey, 1939; Boltanski and Thévenot, 2006; Stark, 2009; Hutter and Stark, 2015), where valuation is characterized by multiple valuation criteria and situations of value uncertainty is used to examine the influence of value judgements on the creative process in more detail. Finally, based on the empirical example of pharmaceutical R&D projects, this contribution seeks to push beyond the prevailing divisiveness between the aspect of generation and valuation and develop a more detailed understanding of the relation between generation and valuation of new ideas within creative processes. For this purpose, three questions are asked: First, to what extend do the varying contexts of the creative process influence the generation and valuation of new ideas? Second, to what extend do negative and positive value judgements influence the creative process? And finally, how can the relation between generation and valuation of new ideas within creative processes be described?

The influence of varying context within the creative process on the generation and valuation of new ideas – a process perspective on creativity

Increased criticism of the understanding of creativity as an individual ability (e.g. Hargadon, 2003; Hargadon and Bechky, 2006; Sawyer, 2007; Sawyer and DeZutter, 2009; Garud et al., 2016) and the collaborative turn (Fortwengel et al., 2017; Ibert et al., 2018) lead to an increased consideration of creativity as a collective process. Following the model of collective creativity (Hargadon and Bechky, 2006: 484), creativity is “the comprehension of a problematic situation and the generation of creative solutions” by “draw from—and reframe—the past experiences of participants in ways that lead to new and valuable insights”. This qualitative change in the understanding of creativity highlights the two aspects of creativity: first, the generation of new ideas is a collective process by framing and reframing past experiences and, second, the valuation of the new idea, because it must lead to new and valuable insights. In order to explore the influence of the varying contexts within thecreative

process on the generation and valuation both aspects are analyzed in more detail – starting with the generation aspect.

The influence of varying contexts within creative processes on the generation of new ideas

The collective process perspective on creativity emphasizes in particular the "incompleteness" (Garud et al., 2008) and the non-linear course of creative processes (Fortwengel et al., 2017). Even as actors try to complete a creative solution by framing and reframing past experiences, they generate new problems as well as new perspectives that continually drive the collective creative process. The quintessence of the continual adaption is a modification of the course of the creative process itself, which leads to a "journey in-the-making" (Garud et al., 2016: 456). Hence, incompleteness is a consequence of the creative process as well as a trigger for action (Garud et al., 2008).

In order to gain a more detailed insight into this creative process, the model of the idea journey (Perry-Smith and Mannucci, 2017) and the model of relational dynamics (Ibert and Müller, 2015) are shortly introduced. While the model of the idea journey (Perry-Smith and Mannucci, 2017: 53) is used to primarily understand the different exigencies (e.g. support, cognitive flexibility) during the creative process, the model of Ibert and Müller (2015: 182) focuses on the idiosyncratic twists of the idea journey in order to classify the relational changes during the creative process. The basic assumption of the non-linear features of the creative process as well as the differentiation of the process into four contexts is common to both models (Perry-Smith and Mannucci, 2017; Ibert and Müller, 2015). In order to successfully work through the different contexts of the creative process the actors develop different needs like cognitive flexibility, support, legitimacy or shared vision and actively adapt their relational and structural network elements as well as their interpretation frameworks of the current context (Perry-Smith and Mannucci, 2017: 53-54). Analogously to Perry-Smith and Mannucci (2017: 61), Ibert and Müller (2015: 193) find that elements which promote one context can hinder another and that actors actively adapt to the current context.

Building on the assumption of the non-linearity of the process, the idea journey (Perry-Smith and Mannucci, 2017: 65-66) includes three feedback loops. If an idea is rejected within the process the recursive loops allow the idea to return to the previous context (Perry-Smith and Mannucci, 2017: 69-70). Due to the feedback loops the actor can adapt the idea accordingly,

whereby new interpretations (e.g. Weick, 1995) and network characteristics can become relevant (Perry-Smith and Mannucci, 2017: 69-70). Contrary to the model of the idea journey (Perry-Smith and Mannucci, 2017) Ibert and Müller (2015: 184) argue that “it seems appropriate to retain elements of linear thinking” to integrate possibilities of fundamental turns in creative processes. Accordingly, the model of Ibert and Müller (2015: 184) contains epistemic facts which subdivide the creative process into a specific order of contexts and once the idea has left a context, the idea, unlike to the idea journey (Perry-Smith and Mannucci, 2017), can no longer return. Hence, epistemic facts can be understood as a kind of gate keeper to be found at the end of each context, where epistemic facts not only create the conditions for the transition to the next context, but also simultaneously generate de facto irreversible decisions and fundamental changes in the creative process on which the subsequent contexts are based necessarily (Ibert and Müller, 2015: 193). Despite their differences in the course of a creative process, both models have in common that they assume four different contexts within the creative process to which the actors adapt. Hence, the creative process as a "journey in-the-making" (Garud et al., 2016: 456) changes within itself. How the changing creative process affects the generation of new ideas, however, remains unanswered.

The influence of varying contexts within creative processes on the valuation of new ideas

After the examination of the influence of the varying contexts on the generation of new ideas, the second aspect of the valuation of new ideas is examined in more detail. As mentioned earlier, ideas within the creative process must not only be generated, but also lead to new and valuable insights (Amabile, 1996; Hargadon and Bechky, 2006). This in turn means that the generated ideas must be valuated within the creative process – on the one hand in terms of their novelty and on the other hand in terms of their value. The problematic aspect of valuation is that the valuation criteria which are used for the attribution of “new and valuable” can vary greatly from actor to actor and between different audiences (e.g. Csikszentmihalyi, 1988; Hutter and Stark, 2015; Hautala and Ibert, 2018).

To illustrate the problem of valuation, the attribution of “new and valuable” is briefly examined using the example of pharmaceutical R&D projects. Novelty as detachment or deviation from known mechanisms and procedures is an integral part of the pharmaceutical R&D and usually measured in relation to existing theories, drugs and therapies. The attribution of novelty in the pharmaceutical R&D is primarily based on standardized patentability

criteria.[1] However, a certain vagueness remains, so that disagreements and, in the worst case, legal patent disputes (e.g. Lemley et al., 2017, Hondros et al.; n.d.) arise. In addition, the valuation criteria for a valuable idea in the pharmaceutical R&D are not standardized and therefore even more diffuse and vague. During the creative process it is unclear if it is the scientific value, the medical need, the clinical impact or the economic value which should be used for the attribution of value. However, it remains unclear how the actors within the creative process deal with the multiple valuation criteria and how different value judgements influence the creative process.

The influence of value judgements on the creative process – a pragmatic perspective on valuation

From an epistemological perspective, positive and negative value judgements are equivalent, but it is assumed that they differ in their logics and how they influence the creative process. Negative value judgements must therefore not be understood as just the opposite of positive value judgements. Rather, studies on negative value judgements and failure especially in the area of learning (e.g. Christianson et al., 2009; Madsen and Desai, 2010; Khanna et al., 2016) have shown that actors (and organizations) learn more effectively from failure than success. Especially in pharmaceutical R&D projects with a success rate of only about 4% (Banerjee and Siebert, 2017: 1256), negative value judgements in form of negative experiment results or failure appear to be a common part of the creative process. However, as mentioned before, the result of valuation and therefore the attribution of value can vary greatly between different audiences due to the simultaneity of multiple valuation criteria (e.g. Csikszentmihalyi, 1988; Hutter and Stark, 2015; Hautala and Ibert, 2018). The simultaneity of multiple valuation criteria in turn leads to so-called situations of uncertainty (Stark, 2009: 24). In situations of uncertainty, it is not the situation itself that is uncertain, but rather the result

[1] According to the German Patent Law an idea must fulfill three criteria in order to be patentable: it must be novel, based on an inventive step and industrial applicable (DPMA, 2018). An invention is considered to be novel if it "does not form part of the state of the art", i.e. if it does not include knowledge which is "made available to the public by any means, anywhere in the world, before the date of filling" (DPMA, 2018). Even if the invention is new, it does not automatically have to originate from an inventive step, but "must sufficiently differ from prior art" (DPMA, 2018). Industrially applicable is the invention "if it can be made or used in any kind of industry" (DPMA, 2018).

of the valuation in the given situation. Uncertainty arises because the valuation is taking place and the result of this valuation is unknown (uncertain). As the contribution deals with the generation and valuation of new ideas and the result of the valuation is uncertain, situations of uncertainty are specified in the following as situations of value uncertainty. Although the attribution of creativity requires not only the attribution of value, rather also the attribution of novelty (in pharmaceutical R&D projects the patentability of an idea), this paper focusses on the attribution of value in pharmaceutical R&D projects, as the valuation criteria are not standardized. Note that, patenting and the interpretation of patent law in pharmaceutical R&D (e.g. Hope, 2009; Heller, 2010; Dutfield, 2017; Leybold, 2018) as well as the discussion of intellectual property are a separate research topic (e.g. Monk, 2009; Pierson et al., 2011; Lemley et al., 2017; Dobusch et al., 2018).

In addition, in order to explore to what extend positive and negative value judgements influence the creative process this paper focuses less on the general problem of valuation between competing major value systems, such as between art and business (e.g. Throsby, 2000, 2003; Klamer, 2003), but rather on the value negotiation process and the construction of value (e.g. Boltanski and Thévenot, 2006; Stark, 2009). Here, it is not primarily important which valuation criteria the valuators use but rather whether value is attributed or not. To develop a better understanding of the influence of value judgements on the creative process the term value and its negotiation process are examined more closely from a pragmatic perspective.

Valuation as a process for organizing value fixations

Following Dewey (1939: 4) value can be understood as verb or as noun, whereby a basic dispute is going one between both understandings. Value as a verb primarily describes a process in which value is socially constructed (Dewey, 1939; Hutter and Stark, 2015). While value as a noun usually refers to an object that can be described as a "valuable something" in everyday language (Dewey, 1939: 4). Based on the assumption that value, however, is not an inherent property of an object or artifact (e.g. Simmel, [1900] 2003), the perspective of value as verb (pragmatic perspective) is taken. Accordingly, it is assumed that valuation is a controversial negotiation process (Boltanski and Thévenot, 2006; Stark, 2009; Hutter and Stark, 2015) that results in a temporary and socially constructed value fixation. In order to deal

with the multiple valuation criteria actors interact and negotiate about which valuation criterion or criteria are operative in a given situation (Stark, 2009: 25). Accordingly, value fixations are socially constructed through negotiation processes between actors (Hutter and Stark, 2015; Kraemer and Brugger, 2017).

Due to the negotiation process, valuation always is anchored in space and time (Hutter and Stark, 2015: 4) and takes place in situations (Dewey, 1939; Muniesa, 2011). In addition to the valuation process itself also the result of the negotiation process (value fixation) is strongly context-dependent and can be denounced or modified by changes in the negotiation context (Peetz, n.d.: 20). The critical dimension of the context-dependence on valuation means that the value of an idea not only varies between different audiences (e.g. Csikszentmihalyi, 1988; Hutter and Stark, 2015; Hautala and Ibert, 2018), but is also influenced by the space-time negotiation context. Subsequently, valuation can be understood as a process for organizing value fixations, which experiences a temporary stabilization through negotiations between different actors in a specific situation and are used by the actors for the attributive construction of value. According to Garud et al. (2008: 367), understanding valuation as a dynamic process that creates value only through interaction means that any value fixation is only an intermediate step in the ongoing valuation, representing both the conclusion of a negotiation process and the beginning of another. The temporality of value fixations creates a kind of incompleteness which, however, is not to be understood as a threat but, similar to the "generative tensions" (Stark, 2009), as an impulse for action and negotiation. If one assumes that value fixations represent positive value judgements within the creative process, the influence of their temporary stability on the creative process remains vague. Furthermore, the occurrence and influence of negative value judgements remain unexplained.

Pharmaceutical R&D projects as an empirical example

The concrete object for the empirical analysis of the relation between generation and valuation of new ideas in creative processes are pharmaceutical R&D projects. Pharmaceutical R&D projects were chosen because they are an integral part of the most research-intensive industries in Germany (EFI, 2018) and therefore a viable starting point for the investigation of the generation of new ideas. The relevance of R&D projects as an integral and creative driving

force of the pharmaceutical industry is emphasized by the highest reinvestment of 14% of sales from its own products in Germany (BPI, 2018). In combination with the extremely high costs of developing a drug of more than one billion euros and the situation that of about 10,000 potential molecules only one substance is approved for the market after eight to twelve years (BPI, 2018), the question which new idea is valuable is extremely important, although several positive value judgements are still no guarantee for a market-approved drug in the end. In addition, the increased opening of pharmaceutical companies to external knowledge sources by for example public-private and industry-academic partnerships as well as through crowd sourcing and open innovation platforms (e.g. Khanna, 2012) leads to an extended search horizon for ideas and increases the possibility of multiple valuation criteria within pharmaceutical R&D projects. The associated intensification of the problem of valuation through multiple and non-standardized valuation criteria confronts the actors with an increasingly complex situation of value uncertainty. Hence, pharmaceutical R&D projects are not only a viable starting point to analyze the generation, but also a good starting point to consider the valuation of new ideas. In addition, pharmaceutical R&D projects can be seen not only as a specific example of the relation between generation and valuation of new ideas in creative processes, but also as a more general example for other fields with scientific-analytical creative processes such as electronics and optics, automotive or aerospace engineering.

In order to investigate the relation between generation and valuation of new ideas in pharmaceutical R&D projects, a qualitative strategy was chosen. Due to the fact that an observation period of seven to twelve years to capture a creative process from one pharmaceutical R&D project was not possible, several pharmaceutical R&D projects in different contexts of the creative process were conducted through expert interviews and participatory observations in laboratories (s. Tab. 1). Additionally, participatory observations were carried out in a mentoring program, at a grant allocation round and at field specific events (s. Tab. 1). Subsequently, the empirical data was analyzed by content analysis.

Type	**Number/Duration**	**Types of data**
Expert interviews with scientists and managers	28	Audio recordings, interview transcripts, notes

Participating observations in laboratories	120h	Field notes, photos, interaction protocols
Participating observations in mentoring program	20h	Field notes, interaction protocols
Participating observations at a grant allocation round	7,5h	Field notes
Participating observations at field specific events	6h	Field notes, photos

Table 1: Overview of the empirical data

The relation between generation and valuation of new ideas in pharmaceutical R&D projects

Based on the empirical data the relation between generation and valuation of new ideas within pharmaceutical R&D projects is analyzed more closely. In a first step, the question to what extent the varying contexts within the creative process of pharmaceutical R&D projects influence the generation and valuation of an idea is examined. For this purpose, it is asked if different contexts can be identified within the pharmaceutical R&D projects and whether actors actively adapt the idea to these. The second step deals with the influence of value judgements on the creative process of pharmaceutical R&D projects and asks whether positive and negative value judgements have a different influence on the creative process. Finally, the empirical results are combined and the relation between the generation and valuation of new ideas in the creative process of pharmaceutical R&D projects is discussed.

Four varying contexts within the creative process of pharmaceutical R&D projects

Based on the creativity models (Ibert and Müller, 2015; Perry-Smith and Mannucci, 2017) and the empirical data it can be shown that the creative process of pharmaceutical R&D projects is subdivided into four different contexts, which pursue their own main aims, research purposes, key valuators and valuation criteria (s. Tab. 2).

Context	Research purpose and main aim	Empirical example	Exemplary valuators and criteria
Basic Research *Incubation **Generation	• Understand the mechanism • Generation of the basic concept of the idea	"As I mentioned earlier, the first animal experiment is decisive for us. If my molecule doesn't work, I don't care why. [...] Above all, I want to help the patient and not understand every mechanism." (p-17.02.09iFS)	• Valuators: Colleagues; Journals; Research field • Criteria: Validity; Transparency
Pre-clinical Research *Validation **Elaboration	• Generate a benefit for the patients • Translation of the idea into a specific clinical application context	"You can determine a diabetes marker in childhood with the probability that you might get diabetes in old age. What does that tell you? Nothing at all. Parents can't work it off with medication." (p-16.08.04iFS)	• Valuators: Mentors; Ethics committee • Criteria: Good Manufacturing Practice (GMP)
Clinical Studies *Mobilization **Championing	• Complete the clinical trials • Adaptation of the idea to a larger clinical application context	"[...] this drug safety is a part or function in the pharmaceutical industry which [...] plays [...] [a] role in clinical research. [...] the quality of the data and documents [...], which effects [...] are statistically valid [...] that ultimately determine what a clinical trial should look like [...]". (p-16.09.14iFM)	• Valuators: Venture Capital; Big pharmaceutical • Criteria: Drug safety regulations
Market Entry *Concretization **Implementation	• Complete the approval process • Generation of a most advantageous placement on the market	"[...] For Great Britain it seems to be too expensive to have half a year more life for 50,000 [USD]. By then, however, the research had already been completed. Only the marketing strategy was adjusted." (p-17.02.09iFS)	• Valuators: Health insurance companies; Specific market • Criteria: Official market approval

Table 2: Overview of the identified contexts for pharmaceutical R&D projects
*Related context of the model of Ibert and Müller (2015)
**Related context of the idea journey (Perry-Smith and Mannucci, 2017)

The overarching task of the basic research context (first context) is the understanding of the mechanism as well as the generation of a basic concept of the idea. Important valuators of the idea in basic research are for example colleagues, relevant journals and the respective scientific research field (e.g. p-17.01.13iRSE; p-17.01.13oRS). By contrast, the main aim of the pre-clinical research context (second context) is on a possible translation of the idea into specific clinical application context,[2] whereby the research purpose is to generate a benefit for the patient (e.g. p-17.02.09iFS). In pre-clinical research, slightly different valuators and valuation criteria come into play like an ethics committee for the animal trials, a set of rules for the production of cells, which is called “Good Manufacturing Practice” (p-17.01.13iRSE), as well as mentoring programs (scientific and economic support), and competitions (e.g. p-16.08.03aiRE). In the clinical studies (third context) the main purpose is to successfully complete the clinical trials. For this to succeed, the idea must be adopted to a larger application context, which means, for example, that in the Phase-I-Studies it must be proven that the idea works in humans and is compatible with them[3] (BfArM, 2013). Here the compliance with drug safety regulations is particularly important (p-16.09.14iFM). Furthermore, clinical trials cost a lot of money[4] so that smaller companies (e.g. start-ups) often seek partners (e.g. big pharmaceutical companies) or sponsors (e.g. venture capital) for their ideas (e.g. p-16.08.01iRS; p-17.01.13iRSE). In the context of the market entry (fourth context), the focus is on the regulatory approval process for the pharmaceutical idea[5] and its most advantageous placement on the market. At this point, pharmaceutical research is usually already completed, so that if difficulties arise, the marketing strategy is usually changed rather than the scientific idea, as one interviewee reports using the example of a non-approval of a drug by the health insurance companies in Great Britain (p-17.02.09iFS). A description corresponding to the empirical finding of the varying context can be found in the model of the idea journey (Perry-Smith and Mannucci, 2017). In the first context the idea is valuated by the

[2] The main goal of pre-clinical research, the translation of the idea from the laboratory into a specific clinical application context is usually described by the interviewees with the term "translation" (p-17.02.09iFS) or the description "from Bench to Bedside" (p-16.08.01iRS).

[3] For the successful completion of the Phase-II-Studies, an exact dosage of the substance must be determined (BfArM, 2013). Phase-III-Studies must identify and quantify possible side effects and interactions of the idea (BfArM, 2013).

[4] The clinical trials require investments of approximately 10 million USD for Phase-I, 30 million USD for Phase-II and 80 million USD for Phase-III studies (p-16.08.01iRS).

[5] Depending on the country or region, different authorities are responsible for market authorisation. In Germany it is the Federal Institute for Drugs and Medical Devices or the Paul Ehrlich Institute (e.g. p-17.01.13iRSE).

actor herself (Perry-Smith and Mannucci, 2017: 53), while in the implementation context the idea is valuated by the field (Perry-Smith and Mannucci, 2017: 59). This description of the two contexts shows that the actors who valuate the idea within the creative process are changing, which also changes the context, since each actor can add different valuation criteria to the value negotiation process. In addition, also the model of Ibert and Müller (2015) provides descriptions of a varying context. However, the vagueness of the valuation criteria still remains within the contexts. For example, a result of a clinical study can still be valuated significantly differently by two actors in spite of the same context-specific research purpose (p-16.08.10iFM).

In addition, despite the ideal differentiation of the creative process of pharmaceutical R&D projects into four contexts, the contexts are not completely independent of each other and the statements of the two creativity models (Ibert and Müller, 2015; Perry-Smith and Mannucci, 2017) that the actors actively adapt to the different contexts and thus also change the context itself can also be found in the empirical material. The actors of pharmaceutical R&D projects are aware that during the creative process new and different valuation criteria are used for the valuation of the idea and therefore try to prepare the idea accordingly (e.g. p-17.01.13iRSE; p-17.02.09iFM). Nevertheless, the main aim and purpose of each context remain predominant and not every actor considers later valuation criteria right at the beginning of the creative process. On the one hand, there are actors who do not want to consider later valuation criteria because they have no interest in converting their idea "into cash" (p-16.08.01iRS) and the negotiations with patent attorneys were stopped. On the other hand, there are actors who are not aware at the beginning of their creative process that their idea can become more than a scientific contribution, so that the idea of patenting or founding a start-up only arises within the creative process itself (e.g. p-16.08.03aiRE; p-17.01.13iRSE). However, as soon as awareness and motivation to shift the context are present, the actors actively adapt their ideas to later valuation criteria. Therefore, they often seek help very actively, for example through mentoring programs or competitions, in which they learn more about the new valuation criteria and are supported in the further development of their idea (e.g. p-16.08.03aiRE; p-17.01.13iRSE).

Despite the anticipated later valuation criteria, however, the idea must first fulfill the current context valuation criteria before the idea can move on to the next context for example due to regulatory requirements or the valuators requirements which corresponds to the idea of

epistemic facts of Ibert and Müller (2015). Regulatory requirements, which must be fulfilled, are repeatedly emphasized by the actors for the context of pre-clinical research, the context of clinical studies and the context of market entry (e.g. p-16.07.27iFM; p-16.07.28iFM; p-16.10.19iFM; p-16.12.09iRS). But also requirements of the valuators, such as the presentation of a proof of concept, are increasingly mentioned by the interviewees, which makes them attractive for funding programs and investors (e.g. p-16.07.29iRS; p-16.08.03aiRE; p-16.10.12iRM; p-16.11.01iRM; p-17.02.22oN; p-17.02.23oN). The generation of epistemic facts in form of a proof of concept "fundamentally change the direction and inner logic of the subsequent [...] trajectory" (Ibert and Müller, 2015: 193). In addition, epistemic facts can be understood as value fixations. During the creative process actors generate epistemic facts at the end of each context by trying to complete a solution. Thereby the actors create a temporary stabilization of the incomplete creative process in the form of an epistemic fact, which at the same time temporarily closes the value negotiation process by representing a value fixation for the specific context. Combined with the ongoing modification of the valuation context the temporary closure of the incomplete process leads not to one single value negotiation, but rather to several value negotiations within the creative process that in turn implies different value fixations.

So far it has been shown that the creative process of pharmaceutical R&D projects can be divided into four contexts (s. Tab. 2) whereby the actors actively adapting the idea to the respective context and if they are motivated and aware they also adapt to later contexts. In addition, the different contexts lead to several value negotiations and generate different value fixation, which can be understood as epistemic facts in the sense of Ibert and Müller (2015). Furthermore, the model of Ibert and Müller (2015) with its epistemic facts and the use of them as valuation criteria seems to be more appropriate than the idea journey (Perry-Smith and Mannucci, 2017) for the creative process of pharmaceutical R&D projects.

Multiple interplays of confirmation and devaluation

Similar to the previous section both creativity models (Perry-Smith and Mannucci, 2017; Ibert and Müller, 2015) provide initial starting points to analyze the influence of value judgements on the creative process. In the idea journey (Perry-Smith and Mannucci, 2017), for example, the situation after a rejection of the idea is described. Here the idea enters the previous

context via a feedback loop and can be modified by the actor (Perry-Smith and Mannucci, 2017: 69-70). Triggered by the negative value judgement (rejection), the idea returns to the previous context in which it is adjusted to the previously unfulfilled valuation criteria until a positive value judgement is reached. The situation described by Perry-Smith and Mannucci (2017:69f) can be understood as an interplay of confirmation and devaluation within the creative process. The term confirmation refers to a positive value judgement whereby the idea complies with the current valuation criteria. Contrary, devaluation describes a negative value judgement whereby the idea does not fulfil the used valuation criteria. Similar descriptions of confirmation and devaluation can be found in the model of Ibert and Müller (2015) as well as in the empirical data. In the interviews conducted, scientists frequently report about an interplay between confirmation and devaluation, with descriptions such as the following statement:

> *"[...] many of these components [we] have modified and further developed so we can do screenings against more antigens [...] in parallel. [...] But nothing has changed about the basic concept of finding new receptors that can be combined for immunotherapy. [...] It has rather been expanded. It is much more widely applicable [...]." (p-17.04.28iRFSE personal translation)*

During the creative process devaluation occurs at a certain point in time because the valuation criterion that several screenings can be done in parallel was not fulfilled. Triggered by the devaluation the idea was "modified and further developed" until the valuation criterion was fulfilled and a positive value judgement (confirmation) was generated.

In addition, the empirical data showed that positive value judgements can become devaluated because of the transition to the next context (e.g. p-16.07.27iFM; p-16.09.29iRM; p-17.02.09iFM; p-17.02.22oN) as for example the statement *“Maybe you get a Nobel Prize [context of basic research] but no patent [context of pre-clinical research]”* (p-16.11.01oNS) shows. Taking the incompleteness of the creative process and the different contexts with their different value fixations in form of epistemic facts into account, epistemic facts can be understood as epistemic objects (Knorr Cetina, 2001: 181). The characteristic feature of epistemic objects is their "lack in completeness of being" (Knorr-Cetina, 2001: 182), so that epistemic objects can exist simultaneously in several forms. Even if an epistemic object is declared as "finished" and "complete", the respective experts are aware “of how it 'could'

have been improved, of what it 'should' have become and did not" (Knorr-Cetina, 2001: 182). Hence, it is assumed that the idea of a pharmaceutical R&D project can be represented simultaneously in different epistemic objects within a creative process and therefore epistemic objects never represent the entire idea, but rather a certain stage of the idea in the creative process. Even if an epistemic object can be declared as complete for a specific context, the same epistemic object is incomplete in the next context. This indicates that positive value judgements are only made within one context and that they are devalued with the transition to the next context, which lead to several interplays of confirmation and devaluation during a creative process.

Building on the assumption that several interplays of devaluation and confirmation can be found in the creative process of pharmaceutical R&D projects the effects of negative value judgements (devaluation) and positive value judgements (confirmation) on the creative process are examine in more detail.

Within the empirical data two main effects of *negative value judgements* were identified. One the one hand, negative value judgements trigger a reinterpretation of the generated idea in ways that lead to a positive value judgement (e.g. p-17.02.09iFM; p-16.08.03aiRE) which corresponds to the understanding of the collective creativity process, which reframes and frames past experiences to generate new and valuable insights (Hargadon and Bechky, 2006: 484). Taking Dewey's assumption (1939: 33, 48) that valuation processes only arise when there is an unsatisfactory situation (negative value judgement) and the understanding that situations of value uncertainty generate an asset (Stark, 2009) into account, devaluation in form of negative value judgement can be seen as an essential impulse for creativity.

On the other hand, negative value judgements lead to critical questioning of the generated results in combination with repeating the experiment. For example, an interviewee (p-17.02.09iFM) reported that during the creative process a problem with the molecule arose, as it worked in the animal experiment but was very toxic. At first, this negative value judgement was very devastating for the project team, but then the result and the course of the experiment were discussed and investigated very carefully, because the project team had expected a different result from the animal experiment. As a result, the interviewee found out that the production of the molecule did not generate the desired molecule, but a very similar – a very toxic one. The critical questioning and repetition of the experiment was very relevant

for the course of the creative process, because otherwise the idea would not have generated a positive value judgement for the current context. By repeating the experiment with the desired molecule, the toxicity could be reduced, so that the idea moved on in the creative process and has now become a market approved drug.

Furthermore, as already mentioned, dealing with negative value judgements is common in pharmaceutical R&D projects (e.g. p-17.02.09iFM; p-17.02.09iFM). Interview partners from a big pharmaceutical company (e.g. p-17.02.09iFM) reported that there is a database with all positive and negative results ever generated in the company. In general, however, negative results exist primarily as experiences in the individual minds of the project members and are usually not systematically documented and recorded in a database. Even though the exact same problems never really arise again within pharmaceutical R&D projects, experience gained in other projects or the advice of other colleagues is sought in order to solve problems and avoid negative value judgements. For this purpose, project members referred not only to their colleagues from other projects (e.g. p-17.02.09iFM; p-16.08.03aiRE; p-17.01.13oRES), but also to presentations at conferences (e.g. p-17.02.09iFM).

Combining both effects of negative value judgements, it can be assumed that negative value judgements are crucial for the creative process of pharmaceutical R&D projects insofar as they lead to a reinterpretation of the idea as well as to a critical questioning of the results and thus represent an essential impulse for the collective creative process.

Contrary, *positive value judgements* within the creative process of pharmaceutical R&D projects seem to follow a different logic – a logic of path dependencies through epistemic facts (e.g. p-16.08.01iRS; p-16.08.03aiRE; p-16.08.04iFE; p-16.09.26iRS; p-16.09.29iRM; p-17.04.26iRS). As mentioned earlier epistemic facts in the sense of Ibert and Müller (2015) can be seen as positive value judgements. Accordingly, positive value judgements in form of epistemic facts generate a "second-degree path dependence" (Liebowitz and Margolis,1995: 207) within the creative process. For example, the decision for a certain target profile of the molecule (positive value judgement), which has to be taken at the beginning of the creative process of pharmaceutical R&D projects where the information is imperfect, can hardly be changed in a later development step (e.g. p-17.02.09iFM) and may appear as a bad decision in retrospect (Liebowitz and Margolis, 1995: 207). Especially in the field of pharmaceutical R&D projects, the element of epistemic facts (Ibert and Müller, 2015) have a great influence

on the further creative process, since, for example, to participate in clinical trials, a number of positive test results must be available beforehand (e.g. p-17.05.15iRM) and almost all parameters and clear yes or no questions must be defined (Ibert et al., 2018: 13), so that the previously positively valuated parameters and target indications can no longer be changed during the clinical trials. If the parameters and the target indication are changed, new preclinical and clinical trials must be carried out.

Concerning the influence of value judgements on the creative process, it can be shown that value judgements within the creative process of pharmaceutical R&D projects not only lead to multiple interplays of devaluation and confirmation, but also that positive and negative value judgements develop different logics and are influencing the creative process very differently. Based on the empirical data it is assumed that negative value judgements are particularly crucial for the creative process of pharmaceutical R&D projects while positive value judgements generate path dependencies through epistemic facts.

Loop of mutual influence and crucial moments of (de)valuation

In combination, the findings from the empirical field of pharmaceutical R&D projects lead to a loop of mutual influence between generation and valuation of new ideas within the creative processes. On the one hand, the creative process can be divided into four contexts which produce different value fixations throughout several value negotiation processes. Furthermore, the actors actively adapt the idea to the current context which leads to an "idea in-the-making". On the other hand, the different contexts also generate different value judgements which in turn lead to interplays between confirmation (positive value judgement) and devaluation (negative value judgement) within the creative process of pharmaceutical R&D projects. Hence, it is assumed that the creative process with its varying contexts influence the generation and valuation of a new idea, whereby the generated value judgements on that idea in turn influence the creative process. However, several moments of (de)valuation occur within the creative process of pharmaceutical R&D projects, which can be understood as disturbance of the loop of mutual influence. Disturbance in the sense that the loop of mutual influence pauses for a moment (the moment of valuation) and generates a situation of value uncertainty. As soon as the situation of value uncertainty is solved by a value judgement, the loop of mutual influence restarts. Hence, it is assumed that the moments of (de)valuation are

crucial within the creative process because they generate and solve situations of value uncertainty and simultaneously modify and stimulate the creative process.

A quote of a laboratory manager is used to illustrate how the relation between generation and valuation of a new idea looks like in pharmaceutical R&D projects and how generated value judgements influence the further course of the creative process. Overall, the manager describes the course of a creative process that ultimately led to a drug that is available for purchase today, whereby the value of the idea changed greatly during the creative process.

> *"By the time I got there, the project was dying. The lead structure just couldn't be optimized. The idea was bought by a start-up at the time. And after 6, 7, 8 or 9 learning cycles[6] we couldn't get any further. But at that time there was a team building up a new library. So, we thought, what the hell, they should get our raw materials and do something with them. [...]And then it was a coincidence that there was exactly one connection that we couldn't explain. [...] And then it's luck that you recognize this irregularity. [...] So this detection of irregularities we've had 2, 3 times with this drug." (p-17.02.09iFM personal translation)*

In this narrative, the idea changes from a valuable idea into a valueless idea and then by reinterpretation back into a valuable idea again. Within the narrative of the laboratory manager several descriptions of different contexts, the interplay of confirmation and devaluation as well as the influence of (negative and positive) value judgements can be identified. First a positive value judgement was constructed, so that the idea was bought by a start-up. Thus, the context changed and the lead structure no longer fulfilled the valuation criteria, which corresponds to a devaluation. Triggered by the devaluation, the project team tried to adapt the idea accordingly to the current context but failed in their trials. Accordingly, the idea changes from a valuable idea into a valueless idea (negative value judgement) that only existed in the sense of raw materials and was voluntarily given to another team for testing, which can be understood as a reinterpretation. Based on the reinterpretation a new reaction was found which could not be explained by the project team and the molecule

[6] Learning cycles are question-answer sessions between chemists who synthesize the molecule and biologists who test these molecules and then return their test results to the chemists who interpret them and make the necessary changes. This question-answer process usually continues until the lead structure of the molecule has been optimized for the intended application.

became valuable again. Overall, this statement shows that the relation between generation and valuation of a new idea within pharmaceutical R&D projects can be understood as a loop of mutual influence, whereby moments of (de)valuation are representing decisive disturbance within the loop. A closer look at the moments of (de)valuation shows that negative value judgements are a crucial impulse for creativity in pharmaceutical R&D projects. Furthermore, the model of Ibert and Müller (2015) with its epistemic facts which are interrupting the general circular features of the creative process seems to be more appropriate than the idea journey (Perry-Smith and Mannucci, 2017) for the creative process of pharmaceutical R&D projects.

Summary

The aim of the paper was to explore the relation between generation and valuation of new ideas in creative processes using pharmaceutical R&D projects as example. Hence, the influence of the varying contexts within a creative process on the generation and valuation of a new idea and the influence of value judgements on the creative process were considered theoretically and empirically. For this purpose, a process perspective on creativity was chosen, in which creativity was understood as a collective process in order to develop new and valuable insights, as well as a pragmatic view on valuation, which is characterized by multiple valuation criteria and situations of value uncertainty.

In order to empirically explore the relation between generation and valuation of new ideas within creative processes a qualitative strategy was chosen and the data collection was limited to pharmaceutical R&D projects. For all of the pharmaceutical R&D projects considered in this work, four different contexts within their respective creative processes were identified in a first analytical step. Further it was shown that the varying contexts within a creative process influence the generation and valuation of a new idea. In a second step it was emphasized that value judgements influence the creative process of pharmaceutical R&D projects and lead to interplays of confirmation and devaluation. In addition, it was shown that positive value judgements generate path dependencies through epistemic facts, while negative value judgements are crucial for the collective creative process in pharmaceutical R&D projects. Finally, the relation between generation and valuation was empirically analyzed in more

detail, leading to an understanding of the relation between generation and valuation of a new idea within a creative process as a loop of mutual influence in which the creative process generates the value of an idea and the value judgements on the idea influence the further creative process, whereby disturbances of the loop by moments of (de)valuation are particularly decisive. It remains open to what extent the developed understanding of the relation between generation and valuation of a new idea within a scientific-analytical creative process can be generalized or even transferred to other more artistic-synthetic creative processes as in the music industry.

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ORGANIZED CREATIVITY

Organized Creativity - Practices for Inducing and Coping with Uncertainty

The aim of this DFG-sponsored Research Unit (FOR 2161) is to examine different dimensions of uncertainty in several practice areas and investigate what role they play in creative processes in different contexts and over time. Therefore four different projects will be conducted, in which the dynamics in both the music and pharma industries will be compared. The focus of all these projects will thereby be the creative process both in organizations and in interorganizational networks.

Principal Investigators

Prof. Dr. Jörg Sydow, Professor of Management, Freie Universität Berlin (Spokesperson)

Prof. Jana Costas, Ph.D., Professor of Human Resource Management, Europa-Universität Viadrina, Frankfurt/Oder

Prof. Dr. Leonhard Dobusch, Professor of Business Administration, Universität Innsbruck

Prof. Dr. Gernot Grabher, Professor of Urban and Regional Economic Studies, HafenCity Universität (HCU) Hamburg

Prof. Dr. Oliver Ibert, Professor of Economic Geography, Freie Universität Berlin, and Leibniz Institute for Social Science-based Spatial Research (IRS), Erkner

Prof. Gregory Jackson, Ph.D., Professor of Human Resource Management and Labor Politics, Freie Universtität Berlin

Prof. Dr. Sigrid Quack, Professor of Sociology, Universität Duisburg-Essen

Prof. Dr. Elke Schüßler, Professor of Organization Theory, Johannes Kepler University, Linz

For further information

http://www.wiwiss.fu-berlin.de/forschung/organized-creativity/

Organized Creativity Discussion Paper