

The imperative of assessing negative creativity in design: a multi-dimensional approach

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Abstract

The paper emphasizes the need to consider negative aspects of creativity, especially in design, where it can have significant societal impacts. It calls for a more comprehensive view of creativity that includes both positive and negative effects and proposes a research approach to assess the potential negative consequences of creative work.

Keywords: negative creativity, research paradigm, design education, research methodologies and methods, design creativity

1. Introduction: The multi-dimensional nature of creativity

Creativity, by its broadest definition, is the ability to generate ideas, solutions, and/ or products that are novel, useful and appropriate (Amabile, 1996). During the last century, creativity research has gained substantial progress in investigating the creative designer in context. The results are a multitude of definitions of creativity (Csikszentmihalyi, 1996; Guilford, 1962; Kaufman & Sternberg, 2019; Torrance, 1995) and a vast amount of empirical research results on creativity in different disciplines (such as music, dance, design, craft, chess, and many more), in different work context such as in teams with various characteristics. But still, there seems to be one issue relevant that is neglected in current research so far. Until now, research on creativity mostly focuses on creativity as a positive solution contribution regarding structuring, problem definition and solution generation (Sternberg, 2021).

Designers often face complex problems with unclear or contradicting goals, with missing, contradicting or wrong information. Nevertheless there is an inherent belief in the individual innovative creativity of the designer that leads to innovation and progress. Furthermore, it needs to be stated that negative creativity should not be confused with a lack of creativity; by contrast, we want to explore the potential of creativity that leads to negative outcomes.

We argue that the negative facets of creativity are an underexplored research field. Negative creativity has the potential to cause harm or yield detrimental outcomes, and it can lead to negative impacts on the outcome of the designers, and even on society. This paper aims to raise awareness about the mostly ignored negative aspects of creativity. We underline the importance of dedicating more research and resources to assess negative creativity in the design context. Furthermore, research needs to investigate the potential risks of creativity, in order to finally provide recommendations for addressing the critical aspects of human creativity. Negative creativity should be identified in the earliest moments of the process to prevent harmful consequences. However, how can negative creativity be assessed when individuals apply creative thinking to devise negative outcomes that are novel but inappropriate,

impressing but ethically harmful? Moreover, there may be aspects of creativity that appear positive but aren't, and vice versa. Hence, with this paper we aim to explore the multi-dimensional aspects of creativity and provide an agenda for possibly assessing negative creativity in design research and practice.

2. Rationales

2.1. Related rationale for the identification of negative creativity

Design creativity is the ability to generate novel and useful ideas, solutions, and artifacts in the realm of design. It encompasses a wide range of design disciplines, including architecture, industrial design, graphic design, fashion design, and more. Creativity has traditionally been treated as an inherently positive force, instrumental in situations and processes of innovation, problem-solving, and systems development. The predominant focus in both academic and professional realms has been on maximizing creative potential toward feasible ends. We argue that creativity is a coin with two sides, and the less explored facet is negative creativity. As [Runco \(2018\)](#) states, creativity is a neutral process; it is neither good or bad – the outcome of creative acting however can have positive or negative consequences. The outcomes of creative efforts can have positive or negative impacts, but – according to [Runco \(2018\)](#) these are not inherent qualities of the creative process itself.

The results of research on design creativity shed light on the impact of creative design processes on the final outcomes. Creativity always relates to a discrepancy between the current situation and the desired situation ([Dörner, 1990](#)); saying it in more general words: there is a mismatch between what the person wants and what is available in the current situation. Most often, these situations cannot be solved at that very moment because information is missing, or resources are not where they should be. Mostly, these problems are not feasible to be treated in a conservative manner, which means within the traditional proven knowledge and methods used before. This can mean that the given problem can be solved with less effort by a creative person compared to a less creative person, who has not got enough creativity and creative thinking to perform a successful process and /or output. Furthermore, it is essential to distinguish between the creative process and its products. Whereas the products of creativity can be evaluated for their moral and ethical implications, the process remains value neutral. According to [Runco](#), this separation is crucial for clearly understanding negative creativity. Another issue concerning the phenomenon of creativity namely that creativity mostly involves deviation from norms and conventions, making it inherently original and sometimes unconventional. However, [Runco and Pritzker \(2020\)](#) explain that these statistical aspects are not necessarily linked to negative connotations. There is some evidence that deviations from conventional and traditional solutions are often not accepted, as human beings do not like deviations from existing norms. Deviations from what humans know threaten existing rules and lead to cognitive uncertainty ([Berlyne, 1972](#)). An extension of this issue to groups provides similar results: If there are no clear roles and defined responsibilities, contradicting knowledge will prevent the individual motivation to solve the problem at hand in a new manner. New ideas and solutions are “per definitionem” creative. However, if the solution can also be harmful for people involved, there can be negative consequences for the team, the process, the environment, and the product.

[Cromptley et al. \(2010\)](#) term the negative aspects of creativity the "dark side" of creativity. This concept challenges the prevailing view that creativity is inherently positive and beneficial. [Cromptley et al.](#) argue that while creativity has led to significant advancements in various fields like art, literature, science, and engineering, its darker aspects – including the use of creative efforts for harmful purposes, such as crime, are overlooked. The consequence of the focus on the genius aspects of creativity has been responsible for its lack of understanding and thus, a lack of strategies to mitigate its negative consequences. What is needed is a new understanding of creativity and a research approach that aims to identify, analyze and develops strategies to manage the dark side of creativity. This includes understanding the influencing variables, processes, and outcomes of negative creativity. At the same time, the term “negative creativity” could also be interpreted in a different way, namely that a negative approach might still lead to a positive outcome.

2.2. Reasonably expected misuse and negative creativity

How can negative creativity be prevented? Let us look at existing guidelines. The concept of reasonably expected misuse and abuse can be one important approach; it is defined in the European Machinery Directive ([European Parliament and the Council, 2006](#)). The European Machinery Directive prescribes legally binding standards for the industry for products that are used or developed in Europe. This means that the expected misuse must be perceived, considered, minimized, or avoided in every case. The interplay between "reasonably expected misuse and abuse" and "negative creativity" is a multifaceted and pivotal aspect, particularly in fields such as technology, product design, and human behavior. Reasonably expected misuse and abuse refer to the anticipation of how users might misuse or abuse a product, system, or service in ways that were not intended by the designers or manufacturers. This consideration is of paramount importance in design and risk management, as it requires designers and engineers to think in various ways how their solution ideas might be used in unintended, often harmful ways. This foresight is not only crucial for minimizing harm and ensuring user safety but also carries legal and ethical implications. Companies may be held legally accountable if they fail to anticipate and mitigate foreseeable misuses of their products. Ethically, there is a responsibility to prevent harm that could arise from such misuse.

On the other hand, negative creativity involves the application of creative thinking to devise harmful, unethical, or destructive ideas. It represents the darker side of creativity, where innovation may lead to detrimental results. Instances of negative creativity can be seen in activities like hacking, creating malware, social engineering scams, and designing deceptive user interfaces, known as dark patterns. These examples demonstrate a deep understanding of human weaknesses and system vulnerabilities, highlighting the psychological aspects of negative creativity. The connection between these two concepts becomes evident when considering design and technology. Anticipating negative creativity becomes a crucial part of foreseeing misuse and abuse. Designers and engineers need to think like a person who might employ negative creativity to exploit or harm. This involves a comprehensive risk assessment and mitigation strategy that includes designing more secure systems, employing better user education, or anticipating behavioral patterns of humans that lead to misuse.

There's also a significant ethical responsibility where designers must balance innovation with the potential for negative use. This balance is particularly critical in fields like AI, biotechnology, and information technology. Neglecting the potential for negative creativity can lead to substantial societal and technological risks. For example, social media platforms are constantly challenged to evolve in response to creatively negative uses such as misinformation and cyberbullying. Furthermore, understanding these concepts is crucial for governments and regulatory bodies in creating effective policies. This comprehension aids in regulating technologies and practices that might be prone to misuse or negative creativity. In conclusion, the relationship between reasonably expected misuse and abuse, and negative creativity, is a complex but vital consideration in modern design, technology, and policymaking. It underscores the importance of foresight, ethical responsibility, and a deep understanding of human psychology and behavior when designing technology and products. Striking a balance between innovation and safety, ethical considerations remain a challenging yet essential aspect of modern development and governance ([Badke-Schaub & Schaub, 2021](#)).

These considerations lead to the following questions that guided this conceptual paper:

- What are the different dimensions of creativity and their potential impact?
- What is the advantage of a multi-dimensional conceptualization of creativity in design research?
- How do we need to change the assessment of creativity and adjust our research?

The remainder of the paper is structured along the four P's – Person, Process, Press, Product ([Rhodes, 1961](#)). In the next section, we present examples of negative creativity for each of the four Ps. Thereafter, we discuss the impact of positive/negative creativity and illustrate the resulting dimensions in a conceptual framework that can lead to the development of assessment tools in future work.

3. Multi-dimensional creativity along the four P's approach/(4P)

In the following, we briefly discuss the concept of negative creativity within the "four P" (4P) approach ([Rhodes, 1961](#)) to address the complexity of the creative person, the process, the environment (press)

and the product. Together, the "4Ps" provide a comprehensive framework for understanding the complexity of creativity. This approach allows us to consider various perspectives and levels of creativity research (specifically also its negative facets), since creativity is a multidimensional phenomenon. Together, the "4Ps" provide a comprehensive framework for understanding the complexity of creativity. They allow researchers and practitioners to consider various perspectives and levels of creativity research.

3.1. Person

Creativity was, over many centuries, understood as a result of genius genes given by God, and therefore only a few people were recognised to be creative. Later research analyzed different individual characteristics that contribute to creativity, including personality traits, intelligence, thinking styles, motivation, and experience of a person. The research examined how these factors influence the individual's ability to generate new and original ideas. However, a person can be negatively creative in two ways: (a) he/she is very creative but with a negative purpose/goal (example: a creative thief or terrorist (Eisenman, 2010)). Or (b) he/she can be overly creative, which would then hinder them from creating a meaningful result (being overwhelmed with creative ideas but not able to decide and finish one). Another aspect to consider is that, nowadays, creativity is considered more of a team effort than the result of an individual creative person. Difficulties in operationalizing negative creativity may be even worse of a challenge in a group setting (Badke-Schaub & Schaub, 2021).

3.2. Process

A negative creative process, in which critical steps are skipped or team members do not work well with each other, will most likely lead to negative results. However, there are some cases that need a more nuanced view. An example of a negative process is "negative brainstorming", in which one would try to reverse the problem-solving process in that sense that one tries to "increase the problem, make it worse", which could then lead to new (positive) solution ideas. Hence, the negative process leads to a positive creative result. Another example where a "bad" creative process could also lead to creative outcomes is to embrace mistakes, which can lead to new ideas through serendipity. Simulations are often used in risk assessments to think of what can go wrong, in order to avoid those harmful, negative events (Dörner, 1990).

3.3. Press (Environment)

Research has indicated that more supportive organizational environments yield higher positive creativity in the workplace (Amabile, 1996; De Alencar & De Bruno-Faria, 1997; Ford, 1999). Another approach has been chosen by Thoring et al. (2017) and Thoring et al. (2021); they investigate the potential of the physical environment to stimulate creativity. Although there is little research on negative creative outcomes from poor climate and lack of support, (e.g. Duffy et al., 2002; Henle, 2005), there is some evidence that perceived negative social climate and relatively low social support are linked (Greenberg, 2011). That strongly imply relatively high underlying levels of negative creativity. Clark and James (1999) have studied the effects of fair treatment on creativity. Fair treatment seems to facilitate positive creative goals and some distinctive creative thinking skills, whereas (perceived) unfair treatment seems to facilitate negative creative goals and some distinctive aspects of creative thinking. However, also here we think that a more nuanced view is needed. A negative environment with constraints and limitations can trigger creative improvisation (for example, an "escape room"). However, also an "uncreative" space might be able to motivate people to be creative and avoid fixation.

3.4. Product

Creativity can be used to intentionally develop harmful products, which would be one dimension of negative creativity in relation to "product". However, a creative product can also be misused in a negative sense, for example, the creative invention of 3d-printing has been misused to print weapons that cannot be detected at airport security scans. In a similar vein, the quite innovative blockchain

technology is nowadays mainly used for drug money laundry or blackmailing. There are many examples that illustrate the potential of a creative product to be misused in a negative way.

3.5. Case example: Robert J. Oppenheimer and the atomic bomb

We briefly use the case of J. Robert Oppenheimer to illustrate the "four P" (4P) approach in order to meet the complexity of the creative person, the process, the press, and the product. This case is considered an example of positive and negative creativity that led to unintended consequences (James & Taylor, 2010).

J. Robert Oppenheimer was an American theoretical physicist, best known as “Father of the atomic bomb for his role as the scientific director of the Manhattan Project, the World War II project that developed the first nuclear weapons. His role as the head of the Los Alamos Laboratory, where the first atomic bombs were designed and built, showed his scientific genius but also his exceptional organizational and leadership skills. Oppenheimer was a researcher who put special interest to the ethical component as to the scientific contribution. And it was one of his most influential roles in shaping the ethical discourse around the use of scientific discoveries in warfare and politics. As a *person*, he was exceptionally creative (Hecht, 2010). The process of the whole Manhattan Project was characterized by positive acceptance and at the same time deep fear knowing the potential of the use of the bomb. The atomic bomb elicited a range of diverse views and reactions from the public that weren't uniformly negative or fearful. While some viewed it with dread due to its destructive potential, others saw it as a symbol of national pride, as witness of human scientific progress. This variety of perceptions challenges the common narrative of the atomic bomb as solely a dark and destructive force, suggesting it also carried more complex cultural meanings. The atomic bomb as a *product* is certainly a harmful and hence, a negative example of creativity, but it is also seen as the symbol of science, symbolizing both, human ingenuity, and the potential for self-destruction. Its creation was driven by the political and societal environment (*press*), categorized by fear of the Nazi regime possessing nuclear weapons, and yes it could end up setting new standards for mass destruction. The atomic bomb is an interesting example that is unique in its interplay between *person*, *process*, and the environment (*press*). It shows how difficult it is to decide what is a positive creative solution and what is a negative creative solution. In any case the product development was a unique creative *process* but led to big international tensions.

4. An agenda for further research into negative creativity

As mentioned before creativity is not a purely positive concept. Obviously, it can have negative facets, but also more subtle, non-obvious positive and negative dimensions that might lead to harmful results, even if not intended. Hence, we argue that since the current state of creativity research appears to be incomprehensive, there is a need to develop new approaches, methods, and tools that find ways to investigate and operationalize the aspect of negative creativity. In the following subsections, we suggest (1) a research agenda for value-based creativity research, (2) a framework outlining four dimensions of creativity, and (3) a confusion matrix for assessing multi-dimensional creativity.

4.1. Research agenda

As creativity research has neglected over decades the negative aspects of creativity, there is an urgent need to gather data in this field. We suggest conducting studies explicitly on negative creativity and to significantly increasing funding and support for research into negative creativity. Moreover, we see the need for more interdisciplinary research: design as a discipline is aligned with a variety of disciplines, such as psychology, ethics, organizational behavior, and other fields. Figure 1 shows the main steps that have to be taken in order to benefit from the new approach on negative creativity.

We propose a value-based approach to creativity research that incorporates possible negative aspects of creativity in research, and creativity education.

More specifically, we suggest a holistic consideration of all aspects of creativity – perceived and actual; positive and negative – when conducting creativity research studies. For this purpose, we suggest three steps: (1) the development of assessment criteria for multi-dimensional creativity, as well as a strategy

for anticipating potential harmful results of creativity. (2) The development of appropriate methods and creativity tests that would take the multi-dimensional aspects of creativity into account (Badke-Schaub et al., 2011). These methods could also include future methods to anticipate a potentially harmful impact of a creative solution (Thoring, Mueller, & Klöckner, 2023).

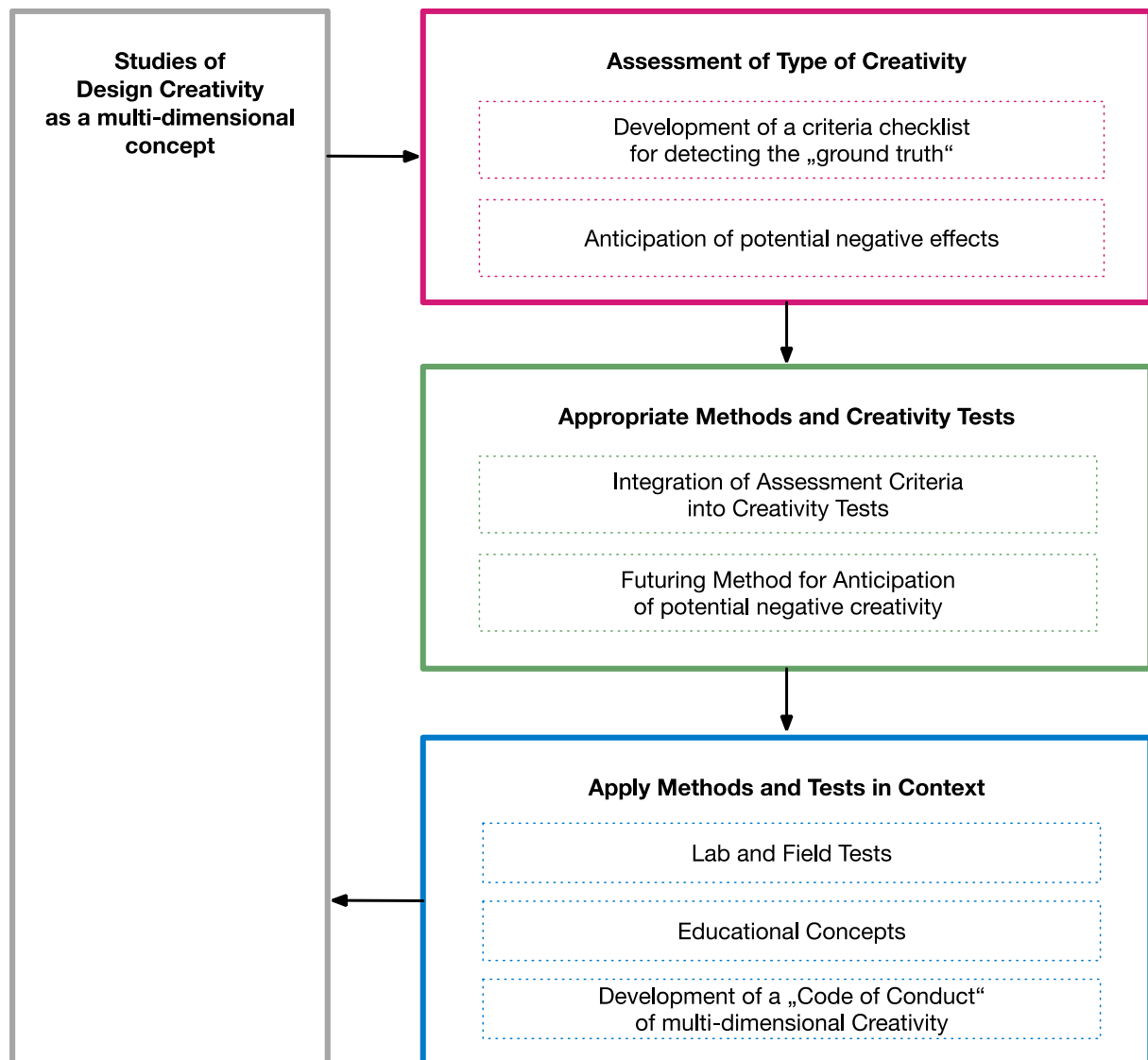


Figure 1. Research agenda for value-based creativity research

These methods would then need to be tested and evaluated to validate their appropriateness (Thoring, Mueller, Lecuna, et al., 2023). And (3) the implementation of these methods and tests into lab and field studies, and into education.

Moreover, we propose the development of a value-based “code of conduct” of multi-dimensional creativity, that would lead to a self-imposed commitment of researchers and educators to be conscious about the potentially harmful dimensions of creativity.

4.2. A framework of multi-dimensional creativity

Table 1 outlines the different dimensions of creativity along the 4P model. We suggest abstract examples of each category to illustrate the nuanced differences in outcome when looking at creativity as a multi-dimensional concept.

Table 1. Four dimensions of creativity, aligned to the 4P model

	Person/Team	Process	Press	Product
True Positive Creativity	A person or team is creative	A creative process leads to creative outcomes	A creative environment fosters creativity	A creative solution solves a problem
True Negative Creativity	A person or team is creative but with a negative/harmful intention; a team does not perform creatively due to negative team behavior	A creative process is used for a negative goal	Negative (toxic) environment hinders creativity	Creativity is used to develop a negative/harmful result
False Positive Creativity	A person or team is too creative which hinders their creative outcomes	A creative process (e.g. brainstorming) leads to free-riding and /or average ideas based on consensus	A creative environment distracts people from their creative work	A creative product/invention is misused for negative purposes
False Negative Creativity	A person or team without creative ideas tries to overcome this with more effort, research, or experimentation.	“Negative brainstorming” leads to positive results; simulation of negative events helps to prevent them; mistakes lead to serendipity	A negative environment triggers people to improvise and come up with creative solutions	A negative/malfunctioning product triggers people’s creativity

The top row addresses true positive (TP) creativity, which is the common understanding of creativity with a positive outcome or impact. The second row addresses true negative (TN) creativity, which refers to creative results in a negative sense. The third row addresses false positive (FP) creativity, which occurs when something appears to be positively creative, but in fact leads to a negative result. And the fourth row addresses false negative (FN) creativity, which involves negative aspects, but leads to a positive result. All four types of creativity are aligned to the 4P model, indicating examples of the respective combination in each cell of the table.

4.3. Operationalization: Assessing multi-dimensional creativity

What is needed is a method to assess the different dimensions of positive and negative creativity, as outlined in the previous sections. So far, there exists little research to measure negative creativity. [Kapoor and Khan \(2016\)](#) suggested a measurement matrix for negative creativity but they did not consider false negative (FN) and false positive (FP) creativity. As a first step in this direction, we suggest a framework in the form of a confusion matrix, which outlines the four dimensions of perceived and actual creativity in relation to each other (Figure 2). This matrix allows us to assess the accuracy, precision, and recall of creativity for each type in an assessment formula, that can be applied to each dimension of creativity.

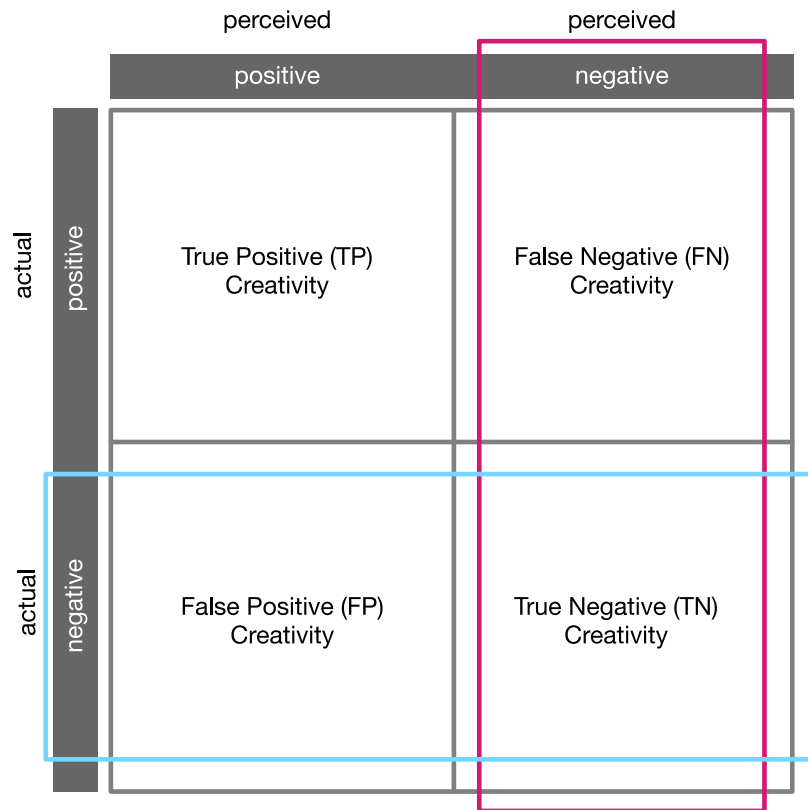


Figure 2. Confusion Matrix of Multi-dimensional Creativity

Accuracy refers to the degree to what the number of creative ideas is correctly perceived, in relation to all ideas. Accuracy can be measured with the following formula:

$$Accuracy = \frac{TP + TN}{TP + FN + FP + TN}$$

Recall refers to the degree of the true negative (TN) creative ideas in relation to all actual negative ideas (or, in other words, in how far one is able to identify the true negative ideas). In Figure 2, Recall is marked in Blue. It can be measured with the following formula:

$$Recall = \frac{TN}{TN + FP}$$

Precision refers to the degree of correctly identified true negative (TN) ideas in relation to all ideas perceived as negative (or, in other words, in how far a prediction of negative idea is correct). Precision is marked in Red in the Figure 2. It can be measured with the following formula:

$$Precision = \frac{TN}{TN + FN}$$

With these formula, we focus on actual negative (= potentially harmful) aspects of creativity (either FP or TN). But all three scores need also be reversed in order to assess positive creativity. For all three types of assessments, a high value is desired. Typically, recall and precision are representing a tradeoff: if precision is high, recall is lower, and vice versa. That means, one needs to add weights or costs to the error types. We would argue that missing a potentially harmful impact of an idea (FP) is more critical than misclassifying a harmless idea as harmful (FN). That means, we suggest to shift the weight of a decision towards optimizing recall.

5. Conclusions

While creativity is the successful attribute in numerous contexts, it is not only a positive influencing variable, but we must recognize that its benefits come with potential risks. The valid assessment of

negative creativity should be a priority for researchers, educators, and leaders who are committed to harnessing creative potential responsibly. With this paper, we illustrate the nature of creativity as a multi-dimensional concept.

Accepting that negative creativity is a valid part of creativity makes it necessary to also adapt the scientific definition of the term creativity. Hence, we propose to expand the widely established definition of creativity by Amabile (1996), which suggests a creative result shall be novel, meaningful, and useful. We propose to add the concept of „appropriateness“ to this definition. A creative result can be useful for someone (with potentially harmful intentions) but not for others or for society as a whole. One should consider if the solution is „appropriate“ (in an ethical sense) in order to determine its degree of creativity.

We further like to promote an agenda for research into negative creativity, and we exemplify an assessment framework to identify potentially harmful creative ideas. We argue that by dedicating time and resources to perceive, identify, and mitigate the adverse effects of negative creativity, we can better safeguard ethical standards and promote a culture where creativity thrives as a force for good.

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