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Creativity of products as meant by ordinary people: to what extent do novelty and usefulness matter?

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Abstract

In the design literature, creativity of products is recognized as a combination of novelty and usefulness. However, this mainly applies to the engineering field and within a community of experts. This study investigates how ordinary people understand creativity embodied in products. In an experiment with 70+ participants, 8 products and 5 metrics were dealt with. Novelty resulted as the main predictor of creativity. Usefulness turned to play a minor effect on perceived creativity. It emerged that usefulness has to make ordinary people like a specific product in order to link it to creativity.

Keywords: design creativity, product design, novelty, ordinary people, creativity assessment

1. Introduction and background

Creativity is normally considered as a desired characteristic of design deliverables and processes (Alexiou et al., 2009). Creativity is nurtured in the whole design process (Valgeirsdottir et al., 2015), along which new emerging representations potentially lead to changes of creativity evaluations (Bao et al., 2018). As the contribution of creativity in design can be best appreciated and valued when the design is completed, the design process has to ensure that creative efforts are reflected in the final embodiment of products (Keshwani and Chakrabarti, 2017). Hence, despite the initial design phases hold the major responsibility for ensuring the creativity of outputs (Borgianni et al., 2018), creativity is eventually manifested and brought to fruition in the final versions of designs (Kim et al., 2007), i.e., products in most cases.

Because of the prominent role of creativity in the field, a plethora of contributions have addressed the problem of assessing design creativity (Fiorineschi and Rotini, 2021). The scope is to recognise what can be actually considered creative in a systematic way, to align the design community on a shared understanding of creativity, to provide means for boosting creativity for processes and consequently products. Despite the efforts made to standardize the evaluation of design creativity, at least two major issues remain open. On the one hand, the metrics to be used to assess design creativity are not completely agreed upon, despite the fact that most scholars consider at least novelty and usefulness as fundamental requirements for a product to be judged creative (Ou et al., 2023). On the other hand, the standardization process has not allowed a fully repeatable measurement of design and product creativity, see e.g., (Fiorineschi and Rotini, 2023). It is evident that most contributions resort to the Consensual Assessment Technique, whose reliability is challenged (Jeffries, 2017), and the involvement of experts because of the lack of objectivity inherent to criteria to judge creativity. Especially if we focus on the creativity of products, the contributions aimed to assess creativity as a combination of novelty and usefulness have proposed structured approaches and rigorous criteria (Sarkar and Chakrabarti, 2011), but margins of subjectivity are still present. In this perspective, the necessity to involve experts is markedly linked to the need to follow evaluation criteria in the strictest way possible (Miller et al., 2021). This does not prevent

individual preferences from arising and playing a role in the assessment of creativity (Wojtczukand and Bonnardel, 2012), which turned as a decisive factor for product development in (Toh and Miller, 2019). It can be expected that these preferences have led to biased judgements and to boosted creativity scores.

In the given context, the motivations of the present paper emerge from the considerations to be found in the following bullet list, which have been already partially touched upon above. For the sake of clarity, "ordinary people" are meant in this paper as laypeople, who, since they are neither designers nor engineers, cannot be designated as experts for creativity evaluations.

- Despite the definition of criteria, most assessments of design metrics take place based on expert judgements. In some cases, creativity is evaluated directly without resorting to the analysis of the metrics that are acknowledged as prerequisites or factors to consider in the overall assessment. These factors can vary substantially across different domains (Miller et al., 2021); the most established ones originate from the study of creativity in engineering design.
- At the present stage, product creativity cannot be evaluated objectively. The involvement of experts does not avoid biased assessments.
- As subjectivity and preferences play a role in any case, the evaluation of creativity made by ordinary people cannot be excluded as a viable option, at least to complement creativity assessments as made so far. The evaluation of creativity is expectedly possible when end products are available, as their characteristics are revealed and understandable by anybody. Furthermore, ordinary people and experts have in principle the same chances of becoming users of creative products, hence creativity evaluations made by all of them might matter for designers.

The literature has largely overlooked ordinary people in the creativity assessment of products, despite creativity is often thought as a value per se also in commercial terms or as market trigger (Horn and Salvendy, 2006; Christensen et al., 2015; Valgeirsdottir et al., 2015). The design literature has devoted large attention to how non-experts judge creativity. Here, limited experience has been intended in relation to the assessment process (Lu and Luh, 2012) and knowledge in a given background. In this respect, situations in which University students are considered as non-experts are common in the literature (Cropley and Kaufman, 2012; Yin et al., 2021). In (Green et al., 2014), students' evaluations were deemed reliable for some metrics of design creativity. In these cases, raters can be seen as lacking some characteristics of expert evaluators, but they cannot be considered extraneous to investigated domains or studied disciplines, as most of them are design students. When non-experts have been involved, their evaluations have sometimes aligned with those of experts (Christiaans, 2002), but this result contrasts with most literature (Becattini et al., 2013; Miller et al., 2021; Hu et al., 2022; Kwon and Kudrowitz, 2023).

In this context, ordinary people can represent an additional category of stakeholders within creativity assessment, at least in relation to products whose evaluation does not require much design knowledge. Even more markedly, it has not been investigated whether the criteria acknowledged as pillars of product creativity in design research are intuitively recognized by people at large. As creativity is relevant for both designers and consumers, especially when products are involved, the investigation of convergences and divergences between these different stakeholders is worthwhile. More specifically, the objective of the present paper is to study the level of association between perceived creativity, preferences, and metrics that can be employed in creativity assessments within a sample of ordinary people.

From a methodological point of view, this study presents marked similarities with other literature contributions where raters have subjectively assessed different metrics, included creativity. The authors have adapted their methodological approach from a number of studies, which are briefly described below, where design creativity ratings have been compared against other metrics that are, however, diffusedly used as creativity indicators. Chulvi et al. (2012) used different assessment methods to verify the alignment of experts' evaluations of creativity, novelty, and usefulness for multiple design concepts. Demirkan and Afacan (2012) involved evaluators of different experience to judge overall creativity and different properties of artifacts produced in a first-year design studio. In (Borgianni et al., 2013), experts' evaluations of creativity were used to verify the meaningfulness of using novelty and usefulness in service design. Freeman et al. (2015) used the Consensual Assessment Technique to find relations between creativity and other quality factors, as well as they investigated the convergence between raters with different levels of experience. Han et al. (2021) asked experts to evaluate product creativity along with common and uncommon metrics to verify the potential role played by functionality and aesthetics. Experts involved by

[Ou et al. (2023)](#) provided an overall evaluation of creativity along with the assessment of other metrics to judge ideas generated in the context of disciplinary diversity in dyadic teams.

2. Materials and methods

The research has been conducted in the form or a real-time online survey by using the tool Mentimeter. Through this tool, it was possible to allow people to evaluate a number of products according to different terms possibly associated with creativity.

2.1. Participants and conditions for their involvement

Participants in the survey were 72 students of a life-long learning program "Studium Generale" enrolled in the course "Creativity I: development of sustainable products", held by the corresponding author at the Free University of Bozen-Bolzano, Italy, as main lecturer. The course was held in Italian; accordingly, the survey was run in Italian as well. Consequently, the textual information that follows for the scopes of repeatability of the experiment is a translation of the original text. The attendees had no specific background in design, architecture, or engineering, as a high school degree is the only requirement for enrolment in the study program. Most of the attendees are curiosity-driven and participate in this life-long learning after their retirement or as a complement to their professional life. The survey has been administered to participants in the first class of the course in its last three editions (from the academic year 2020/21 to 2022/23), when attendees did not yet avail of slides and materials about the taught topic. In this sense, despite their presumed interest in creativity, they are considered here as ordinary people due to their non-involvement in technical studies and missing notions of creativity, especially as regards design creativity. Otherwise said, it is assumed in this paper that their notion of creativity is unaffected by design knowledge and can be considered equivalent to the ordinary non-disciplinary understanding of the term.
The corresponding author oversaw the administration of the survey during the classes.
As no personal, demographic or sensitive data was gathered, the execution of the survey required no authorization by the privacy and ethical committees of the University.

2.2. Used evaluation metrics

Metrics used to evaluate each product were chosen based on the objectives of the paper. The metrics were assessed by asking the participants to indicate to what extent they agreed with the statement that the shown product is:

1. Creative (variable *creative*);
2. Liked (variable *likeit*);
3. Useful (variable *useful*);
4. Cool (variable *cool*);
5. Novel (variable *novel*).

For all the products, the order of evaluations was the same to accelerate the answering process. The authors wanted to separate "Creative" and the metrics "Useful" and "Novel", which were in focus, to avoid aware connections between them; this is the reason for their position (1, 3, and 5) in the list. More in details:

- Metric 1 was chosen as the main reference for comparison;
- Metrics 3 and 5 are, as aforementioned, the most acknowledged criteria to evaluate design creativity of products, e.g., ([Sarkar and Chakrabarti, 2011](#));
- Metric 2 was included to judge how preferences matter, in line with the arguments made in Section 1;
- Metric 4 was used as a possibly misleading factor; it is uncommonly listed among creativity metrics, e.g., ([Im et al., 2015](#)).

All the statements were to be answered through a 6-point Likert scale (0 to 5), where the points were indicated in increasing order with "I totally disagree", "I disagree to a large extent", "I disagree to some extent", "I agree to some extent", "I agree to a large extent", and "I totally agree".

2.3. Products to be evaluated

The participants were administered 8 products for evaluation. Because of the use of a real-time surveying system, each participant of the same cohort was displayed the same product at the same time. All the products were displayed through a picture, freely accessed from the Internet, and a text, reported in Table 1, to make sure that all participants could understand the main traits and function of the products. Efforts were made to make the length of explanatory texts similar and the descriptions concise. The products were chosen based on the following characteristics and criteria to get a sufficiently varied mix.

- Different levels of the urgency of the need to be satisfied, from medicine to decoration.
- Different expected frequencies of use.
- Different industrial domains.
- Different degrees of technical complexity.
- Inclusion of local artefacts.
- Inclusion of products typically found in sets of surprising products, which represent a peculiar domain of design research (Becattini et al., 2020), and absurd items.

Table 1. Products used for the survey and descriptions thereof

Product ID	Picture	Description text (translated into English)
P1		This bike does not need a chain and a pole is enough to park it.
P2		This egg carton is suitable for families with only a few people, so to prevent eggs from going off.
P3		With this stick it is much easier to spread butter.
P4		With this device with micro-needles there is no need to use a syringe for injections and vaccines. Much less annoying.
P5		With this umbrella for couples you only need one person to hold the umbrella.
P6		You don't have to bend down to tie these shoes. The strings tie themselves.

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P7		An elegant way to arrange bananas in the kitchen, resulting in an artistic creation.
P8		This swimwear removes algae and other pollutants from the sea thanks to a special sponge.

In order to receive unbiased evaluations, especially with regards to novelty, the participants were instructed not to answer in case they already knew the shown products.

2.4. Data collection

The duration of the test lasted from 10 to 17 minutes based on the speed of answering displayed by the three different cohorts of students. Data of each cohort was then extracted through the functionalities of the used surveying system and joined together. The data was then structured into respondent (with IDs from 1 to 72), product analysed (from P1 to P8 in line with Table 1), and metrics, whose corresponding variables are indicated above and whose values corresponded to the answers given through the Likert scale. Some data was missing because of participants reaching the class when the survey had already begun, experiencing issues with the survey system, abstaining from answering or knowing some products. For each product, evaluations have been made by at least 59 people across all metrics.

3. Data analysis and results

All the statistical analyses that follow have been conducted with the software R.
In order to explore the correlation between all metrics, Spearman correlation coefficients have been calculated, see Table 2. All the correlations are positive and their p-values are below 0.001 (not shown for the sake of simplicity), showing the considerable interdependence across the different evaluation terms used in the survey.

Table 2. Spearman correlation among the variables used for product evaluation

	creative	likeit	useful	cool
likeit	0.5171			
useful	0.3503	0.6614		
cool	0.5114	0.6678	0.4597	
novel	0.5024	0.5094	0.4907	0.4792

Based on value ranges proposed by (Landis and Koch, 1977), the perceived creativity is fairly correlated with usefulness and moderately correlated with all the other metrics. The possible effect of novelty on creativity is comparable with the influence of preferences and perceived coolness, i.e., those metrics leveraged here and typically not included in the assessment of creative designs. Moreover, it is possible to notice that the linkage between creativity and usefulness is the weakest across all the couples of variables. The strongest correlations, to be considered as substantial according to (Landis and Koch, 1977), concern likeability as regards its linkage with usefulness and coolness. In other terms, positive judgments of usefulness seemingly affect the extent to which people like products more than their perceived creativity. This observation led the authors to investigate these phenomena further and to consider the potential effect of products.

In a first instance, a mixed-effects regression model was run, where *creative* was included as dependent variable, while the other metrics, as well as their interactions, were used as fixed-effects predictors. Products and participants' IDs were used as random effects to control for possible sources of variance. In the model, the t-tests use the Satterthwaite's method. The ensuing results are presented in Table 3. Here and in the followings, significant p-values are indicated with one, two or three stars when their value is below 0.05, 0.01, and 0.001, respectively. Interactions between variables to highlight moderating phenomena are indicated with a colon in the first column of Table 3 and in the followings.

Table 3. Results of the mixed-model to predict products' creativity

Variable	Estimate	Standard Error	t	p value
(Intercept)	1.221	0.276	4.424	0.0001***
likeit	0.508	0.230	2.214	0.0272*
useful	0.065	0.171	0.382	0.7027
cool	0.055	0.106	0.514	0.6077
novel	0.318	0.092	3.443	0.0006***
likeit:useful	-0.079	0.089	-0.894	0.3716
likeit:cool	-0.051	0.067	-0.761	0.4468
useful:cool	0.026	0.080	0.323	0.7465
likeit:novel	-0.064	0.075	-0.853	0.3943
useful:novel	0.007	0.054	0.125	0.9008
cool:novel	0.037	0.044	0.852	0.3946
likeit:useful:cool	0.023	0.027	0.836	0.4036
likeit:useful:novel	0.009	0.024	0.385	0.7000
likeit:cool:novel	0.003	0.021	0.131	0.8958
useful:cool:novel	-0.014	0.023	-0.607	0.5444
likeit:useful:cool:novel	-0.001	0.007	-0.146	0.8836

The results show that novelty and preference are the only significant predictors of perceived creativity. Both estimated regression coefficients are positive. Despite the previously highlighted correlation of creativity with coolness and usefulness (to a lesser extent), these two variables do not have a significant explanatory power when other phenomena are contextually considered. Interaction effects across variables are not significant and supposedly self-excluding; more products should be included in the survey to evaluate them effectively.

To focus on the possible role of products, a series of mixed regression models were built to detect different behaviours in the relationship between creativity and the other metrics. While creativity was again the dependent variable, the fixed-effects predictors were the Product (eight levels), one of the four metrics (as continuous predictors), and their interactions. The four metrics were investigated one at a time, separately in each model. This helped to identify how product peculiarities could be moderating factors in the prediction of creativity, with respect to the different metrics. P1 was chosen as a term of comparison. Results are illustrated in Table 4; they are here limited to estimates (Estim., to establish the direction of the effects) and p-values (to show the significance of the effects) for space reasons. Interested readers can contact the corresponding author for getting the whole set of statistical results.

As for mixed models considering liking, usefulness and coolness, differences clearly and expectedly emerge between values attributed to metrics across different products, but no significant interactions between metrics and products can be observed. This means that, for instance, the product P2 is liked significantly less than P1 (see the negative estimate of *ProductP2* and the corresponding p-value in the columns for the label *likeit*). Conversely, when the interaction between the product and the metric is significant, it means that the slope of the estimated line for such a product is different from the slope of the reference product P1. Following the example, the non-significant p-value associated to *likeit:ProductP2* means that creativity grows as preference increases at the same rate in P1 and P2. Significant interactions are instead found when novelty is evaluated in products P4 and P5. Given the

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significant p-values and the positive estimates, perception of creativity increases significantly faster in P4 and P5 than in P1 as perception of novelty increases. This is graphically shown in Figure 1, where the interpolated straight lines showing the relation between creativity and novelty are more inclined for P4 and P5 than in the other products.

Table 4. Results of mixed regression models focused on differences between products

Metric->	likeit		useful		cool		novel	
Variable	Estim.	p-value	Estim.	p-value	Estim.	p-value	Estim.	p-value
(Intercept)	2.829	0.0000***	3.021	0.0000***	2.817	0.000***	2.607	0.000***
metric	0.374	0.0001***	0.300	0.0071**	0.355	0.0004***	0.307	0.0067**
ProductP2	-1.874	0.0000***	-2.013	0.0000***	-1.724	0.000***	-1.757	0.0008***
ProductP3	-0.503	0.1936	-0.361	0.3831	-0.512	0.229	-0.082	0.8818
ProductP4	-1.073	0.0109*	-1.568	0.0011**	-0.936	0.0252*	-1.665	0.0063**
ProductP5	-0.930	0.0161*	-0.976	0.0197*	-0.595	0.1317	-1.052	0.0529
ProductP6	-1.401	0.0017**	-1.214	0.0078**	-0.832	0.0734	-0.988	0.0709
ProductP7	0.134	0.6962	0.293	0.4139	0.208	0.5836	0.258	0.6085
ProductP8	-0.781	0.0451*	-0.588	0.1633	-0.844	0.0457*	-1.476	0.0197*
metric:ProductP2	0.140	0.3371	0.081	0.5743	0.231	0.1426	0.236	0.1326
metric:ProductP3	0.114	0.3711	0.121	0.4097	0.064	0.6194	0.056	0.7025
metric:ProductP4	0.109	0.4044	0.223	0.1244	0.134	0.3055	0.301	0.0450*
metric:ProductP5	0.126	0.3112	0.171	0.2233	0.068	0.5949	0.292	0.0441*
metric:ProductP6	0.152	0.2658	0.138	0.3475	0.001	0.9931	0.211	0.1489
metric:ProductP7	-0.044	0.7311	-0.021	0.9004	-0.141	0.2626	0.014	0.9235
metric:ProductP8	0.059	0.6502	-0.018	0.902	0.080	0.5534	0.259	0.1077
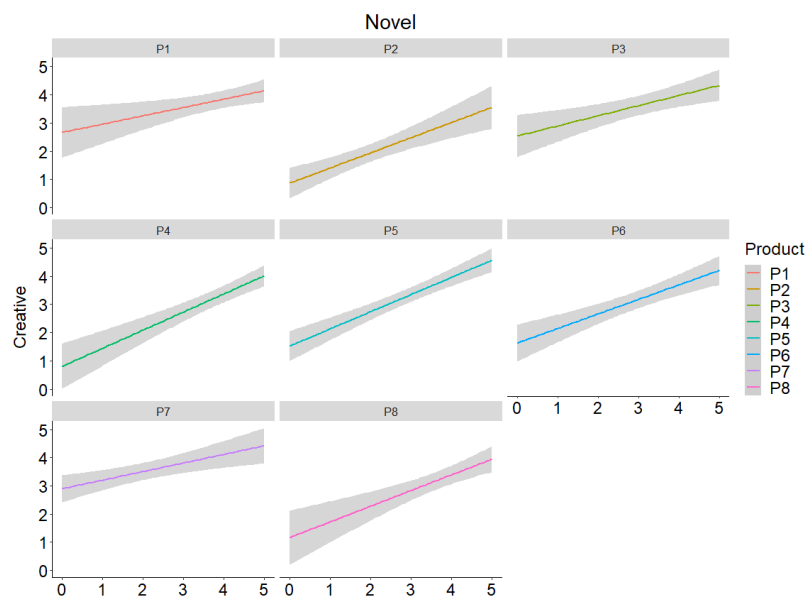
Figure 1. Relations between creativity (y-axis) and novelty (x-axis) divided for the eight products; In each panel, the grey areas indicate the variability associated to the estimated line

4. Discussions and conclusions

In engineering design, product creativity is recognized as a combination of novelty and usefulness; some scholars include additional metrics to assess it. In some studies, the relationship between creativity and other design aspects is focused on, as shown in Section 1. Efforts are made to make the assessment of product creativity as repeatable and objective as possible, but this goal has not been accomplished yet.

Experts' involvement along with subjective issues are still a common trait in most studies on design creativity. The present research is concerned with the understanding of the terms that are mostly associated with creativity when ordinary people are asked to assess products. This objective emerges as the need to verify the understanding of creativity as a mix of novelty and usefulness within a non-expert audience, as the involvement of people with relatively low experience has become common in research. On the other hand, it is here claimed that the view of ordinary people on product creativity plays a role as these people can better reflect consumers' perspective with clear ramifications in design.

An experiment tailored to test the level of association between creativity, preferences and other metrics was conducted. The results have laid bare that all the investigated terms are significantly correlated. However, the correlation between creativity and usefulness is not as strong as others. A statistical regression analysis shows that usefulness is a poor predictor of creativity in the evaluations made by the involved sample of ordinary people. This contrasts with the relationship between creativity and novelty, which emerged as the best predictor of creativity in the same regression analysis. Otherwise said, while we can assume that novelty is generally understood by non-specialists as a prerequisite of product creativity, the same cannot be affirmed in relation to usefulness. This applies even though the positive fair correlation between usefulness and creativity might indicate that usefulness is considered as a means to strengthen perceived creativity by some people.

As regards novelty, the outcomes of the study could be expected since the creative act presupposes the realization of something that did not exist before. It is difficult to explain that novelty's capability to predict creativity is accelerated in some products (P4 and P5), as these specific products are featured by very different fields of application, technological sophistication, potential societal impact.

On the other hand, the authors assume that usefulness could be seen as something to be taken for granted in certain disciplines where the utilitarian factors are in focus, e.g., engineering and medicine. Conversely, in other domains, e.g., arts and graphics, usefulness could be thought as unnecessary to make an artifact creative. These assumptions are backed by the non-significance of the interaction between usefulness and specific products, which indicates that the poor explanatory power of usefulness in creativity evaluations. Despite the reasonableness of these assumptions, they should be verified through follow-up studies.

An important finding of the paper is the disclosed impact of preferences on creativity evaluations. The extent to which a product was appreciated by the involved sample of ordinary people resulted as the factor mostly correlated with creativity and as a significant predictor. This aspect supports our speculation (see Section 1) that people could be biased to consider the products they prefer and like more creative. On the one hand, this confirms the generally positive understanding of creativity by consumers. On the other hand, this calls into question the effect of possible experts' bias in the research on design creativity assessment, which has been insufficiently addressed in the literature. The substantial correlation between preferences and usefulness could have obfuscated the role of the latter in explaining what is creative. In addition to the above considerations on usefulness, usefulness can be therefore seen as a term to indirectly affect creativity as a result of leading people to recognize and appreciate the utilitarian dimension they see in the product. Similar conclusions can be made as regards the substantial correlation between preferences and coolness. The hypotheses emerging from these correlations are worth investigating further.

Despite the paper offers a new viewpoint on how creativity embodied in products is seen by ordinary people, which is the original trait of this research, this study is not immune to limitations. First, the context in which the study was run prevented the authors from acquiring information about the participants' background, which could have led to exclude some results from the sample. However, discussions with students following the survey gave rise to some perplexity when the corresponding author stressed that usefulness has to be considered as a prerequisite for design creativity, which supports some of our assumptions on the overall neglect of the topic at the time of the survey. Second, the investigated products were chosen without resorting to any standard list for verification, which is unavailable based on the authors' best knowledge. The diversity of the products according to the criteria declared in Section 2 has not been validated. The number of products was constrained by the time possibly dedicated to this activity during the lecture. Third, contingent factors affected also the form of presentation of the products, as the time and the space available allowed for the use of images to depict

the products only; besides some classes were held online because of Covid-related restrictions. Different forms of representation could have given rise to different evaluations and appraisals as suggested in (Berni et al., 2023), including the assessment of creativity and other factors. Fourth, the metrics and factors for which association with creativity was studied were chosen in a partially arbitrary way. The mentioned time constraints discouraged the investigation of more than four terms along with perceived creativity.

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