

## Article

# The Bridging Role of Goals between Affective Traits and Positive Creativity

Hung-Hsiang Wang <sup>1</sup> and Xiaotian Deng <sup>2,\*</sup>

<sup>1</sup> Department of Industrial Design, National Taipei University of Technology, Taipei 10608, Taiwan; wanghh@mail.ntut.edu.tw

<sup>2</sup> College of Design, National Taipei University of Technology, Taipei 10608, Taiwan

\* Correspondence: t108859404@ntut.edu.tw

**Abstract:** Positive creativity training is crucial for 21st century learning, yet the influence of affective traits and goals with different intentions on positive creativity is unclear. We held a creativity training workshop for fifty-four undergraduates to determine its influence. We first assessed participants' affective traits (risk-taking, curiosity, imagination, and complexity) using the Test of Divergent Feeling from the Creativity Assessment Packet. Then, we provided participants with twenty-seven products as inspiration sources for designing novel staplers. Each participant was asked to define a certain design goal, for which they chose one of the inspiration sources to generate ideas. We assessed the novelty of ideas and classified them according to the goals with different intentions. Results showed a bridging role of the goals between affective traits and creativity. This role was reflected in positive correlations between (1) curiosity and novelty with effort-saving goals; (2) complexity and novelty with orderliness goals. In addition, we found participants with high risk-taking tended to set versatility goals; the orderliness goal led to the highest novelty of ideas. Our findings suggested that teachers should pay attention to students' affective traits and guide them to set goals in positive creativity education.



**Citation:** Wang, H.-H.; Deng, X. The Bridging Role of Goals between Affective Traits and Positive Creativity. *Educ. Sci.* **2022**, *12*, 144. <https://doi.org/10.3390/educsci12020144>

Academic Editors: Robert J. Sternberg and Sareh Karami

Received: 27 January 2022

Accepted: 19 February 2022

Published: 21 February 2022

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Keywords:** creativity; affective trait; goal setting; novelty; teaching

## 1. Introduction

The training of positive creativity is essential for 21st century learning. Outcomes of creativity are not always positive [1,2]. For example, the atomic bomb is a creative product but has brought disaster to humankind. Positive creativity refers to the creativity that can lead to valuable, positive, and virtuous outcomes for humans [3,4]. Since creativity can be improved through training [5–7], positive creativity can be learned to create positive solutions and minimize negative manifestations [1]. Therefore, the training of positive creativity needs to be integrated into learning.

Specific factors related to positive creativity need further exploration. Affective traits and goals are two significant factors influencing positive creativity. Previous studies have found that affective traits and goals can directly or indirectly influence positive creativity [8–10]. However, different affective traits have dissimilar characteristics, which may lead to different impacts on positive creativity. Moreover, the goals with different intentions are rarely discussed. Goal intentions are important because they have an influence on goal setting and creativity.

The current study aims to explore the influence of affective traits and goals on positive creativity. The rest of this section introduces positive creativity, affective traits, goal setting and intentions, and analogical reasoning for creativity training. Section 2 introduces the research method; Section 3 presents the results; Section 4 discusses relationships between affective traits, goals, and positive creativity; Section 5 concludes this study.

### 1.1. Positive Creativity Training

Creativity workshops are an appropriate way for positive creativity training because the participants' brains can be well stimulated [11]. Creativity workshops usually require participants to solve a problem in such workshops, where participants need to get inspiration from stimuli and generate ideas through specific approaches. Especially at the idea generation stage, the participants often associate the problem with other different but related things to generate ideas. For either novices or experts, the creativity workshop is a practical method to encourage blue-sky thinking for producing new ideas.

Novelty is the primary indicator of creativity. It refers to uniqueness or rarity in ideas [1,12]. An idea is not novel if most people can easily generate it. Creativity requires achieving a certain goal by applying novel ideas or means [3,13,14]. Therefore, novelty is commonly used to evaluate the creativity of ideas [15–17]. Novelty is more suitable for creativity workshops than other creativity indicators (such as feasibility and usefulness) because creativity workshops focus on creativity stimulating within a limited time. Students are usually encouraged to produce novel ideas rather than feasible or useful ones.

However, not every individual can improve their creativity by training. Some hardly develop novel ideas in creativity training. The factors that affect the novelty might explain the phenomenon. Among them, the current study focuses on two significant factors: affective traits and goals.

### 1.2. Affective Traits

Affective traits are a significant factor related to positive creativity. Affective traits involve individual motivation, personality, and attitude that affect the development of creativity [9]. Motivation provides powerful energy that drives people to create novel things [1,18–20]. Personality and attitude are closely related to personal creative performance [21–23]. Many researchers argue that affective traits are indispensable to creativity [24–26]. Agreeing with the aforementioned studies, more researchers claim that affective traits have impacts on creativity in working [27,28], teamwork [29], and design processes [30].

Nevertheless, the relationships between affective traits and creativity are arguable. Some studies assert that affective traits rarely reflect an individual's current creative abilities, though they are indicators of the individual's future creativity [31,32]. James, Clark and Cropanzano [13] declare that positive affectivity tends towards positive creativity. Unlike these views, another relevant study by Amabile, Barsade, Mueller and Staw [27] points out that affect is, directly and indirectly, related to creativity. In their view, affect is concomitant of the creative process and positive affect facilitates cognitive variations related to creativity. However, they rarely discuss different aspects of affective traits, which may have dissimilar influences on positive creativity.

Four aspects of affective traits related to creativity are identified by Williams [33], including risk-taking, curiosity, imagination, and complexity. First, the risk-taking refers to a spirit to explore, practice, and experiment in an unknown situation; it is a significant predictor of creativity [9,34]. Second, curiosity represents a willingness to investigate mysterious things or an eagerness to pursue doubtful questions; it is a positive motivation for seeking novelty [35,36] and has importance because motivation impacts creative activities [1,37,38]. Third, imagination is defined as the quality of visualizing and establishing mental images beyond reality with unlimited possibilities. It is a core part of creativity [39,40]. Finally, complexity refers to the characteristics of sorting out clues and developing solutions for complex or chaotic problems. To the best of our knowledge, no previous research has considered the effects of different affective traits on positive creativity. The current study focuses on these four aspects of affective traits.

### 1.3. Goal Setting and Intentions

Goal setting is another significant factor related to positive creativity. Goals in positive creativity involve problem-solving, product improvement, and process optimization [13].

They can guide an individual's attention and efforts to essential aspects of a task, meaning goals help focus attention on creative aspects [10,41–43]. In particular, the goal can stimulate creative thinking by guiding attention to novelty [8,44]. An individual focuses more time on creative thinking when a certain goal is given, whereas he or she loses focus on thinking without such a goal [8,44].

There are various types of goals. An important question is what kind of goal is better to produce creative ideas? Shalley [44] found that the subjects with the goal of do-your-best produced more creative ideas than those with no creativity goals. However, the definition of the do-your-best goal is too general to compare the advantages of different types of goals on creativity and thus needs further classification.

Goals can be classified according to intentions. Goal intentions represent individual wishes or desires related to the problem someone wants to solve [45]. For example, a goal is set as “design a small camera to put it in the pocket”. Its underlying intention could be “easy carrying”. An individual usually sets his or her most desired goals, which are strongly related to individual intentions [1,45]. We will classify the goals according to their intentions and use them to analyze the workshop outcomes described in Section 3. Furthermore, considering that goal intentions are closely related to individual affective traits [46], we argue that affective traits may influence goal setting through intentions.

#### 1.4. Analogical Reasoning for Learning Creativity

Creativity can be learned by means of analogical reasoning. Analogical reasoning is an excellent approach to creative thinking [47,48]. It transfers known knowledge (source) to unknown things (target) for problem-solving. Analogical reasoning helps us understand the unknown phenomena creatively [49], such as using the solar system to describe the unknown atomic system [50]. It also helps produce creative solutions [51–54]. A famous example is Velcro, which was invented by studying the structure of burdock seeds. The creative characteristics of analogical reasoning associate it with creativity. Many studies have found benefits of analogical reasoning training for enhancing students' creativity [55–57], improving thinking ability [58], and developing innovative solutions [59–62]. Therefore, the current study emphasizes analogical reasoning for creativity training.

#### 1.5. Research Hypotheses

The current study aims to explore the impacts of affective traits and goals on positive creativity. Considering that individual affective traits may determine the goal setting, we propose the first hypothesis (H1):

**Hypothesis 1 (H1):** *Affective traits have an effect on goal setting.*

Because the goals can stimulate creative thinking by guiding attention to novelty [8,44], we propose the second hypothesis (H2):

**Hypothesis 2 (H2):** *Goals with different intentions have an effect on novelty.*

That the affective traits are closely related to creativity suggests the third hypothesis (H3):

**Hypothesis 2 (H3):** *Affective traits have an effect on novelty.*

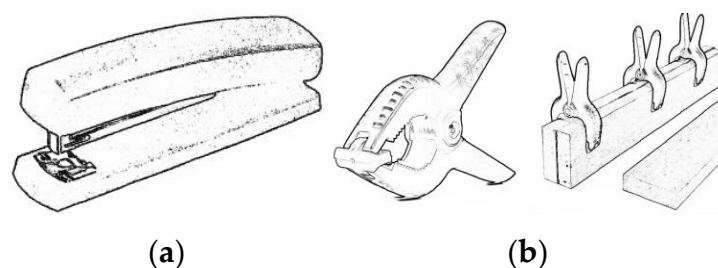
## 2. Methods

### 2.1. Participants

Participants were 54 undergraduates, including 38 males and 16 females (aging from 18 to 21,  $M = 18.93$ ,  $SD = 0.47$ ). All participants were from National Taipei University of Technology and were recruited to participate in a workshop of redesigning a stapler.

## 2.2. Target, Stimuli and Worksheet

The target was to redesign the typical stapler shown in Figure 1a. The stapler was a popular commodity that the participants had used. The goal was to produce creative ideas to solve problems when using the stapler. Twenty-seven industrial products were selected as analogical sources for inspiration (see redrawn pictures in Figure 2). We carefully selected and downloaded the images of these sources from Amazon.com and Google.com. The selection criterion was the typicality of staplers (i.e., the generic quality of the most representative of staplers available in our everyday living). Each image contained a main view and a usage scenario of the stimulus. Figure 1b showed a redrawn example: the main view of the spring clamp and the usage scenario where spring clamps were clamping two wood boards. The worksheet was a paper in A4 size. Each participant needed to sketch and write down the description of their idea on the worksheet.



**Figure 1.** The redrawn pictures of target and an example of stimuli: (a) stapler; (b) spring clamp.



**Figure 2.** The redrawn pictures of stimuli.

## 2.3. Affective Creativity Assessment

We used the Test of Divergent Feeling (TDF) for affective creativity assessment, which was one of the tests in the Creativity Assessment Packet (CAP) created by Williams [33]. For convenience, we chose the Taiwanese edition of CAP by Lin and Wang [63]. The TDF measures affective traits, including risk-taking, curiosity, imagination, and complexity. The test–retest reliability with an interval of 10 months was in the 0.60s, and the validity was 0.76. The TDF contained 50 self-assessment questions, including 12 risk-taking, 13 curiosity, 13 imagination, and 12 complexity questions. Forty of them were positively worded questions (e.g., “I like something different”) and ten of them were negatively worded questions (e.g., “I do not like too many rules”). Participants needed to answer “completely agree”, “partially agree”, or “completely disagree” for each question. The points were 3, 2, and 1 for positively worded questions; 1, 2, and 3 for negatively worded questions. There was no time limit for TDF, but participants were asked to finish the test as soon as possible.

## 2.4. Idea Novelty Assessment

We used the novelty assessment method proposed by Fu, Chan, Cagan, Kotovsky, Schunn and Wood [15] to evaluate ideas. This method assumed that novel ideas were rare and conceived by fewer people. Each idea provided one or more solutions to the problem.

Solutions were coded as a sub-function defined by Hirtz, et al. [64]. The sub-function contained three components: (1) *what*, the type of sub-function (e.g., energy or a part of the human body such as the foot); (2) *how*, the component implementing the sub-function (e.g., pedal); and (3) *compound*, the compound component of what and how (e.g., the foot stomps on the pedal). The novelty ( $n$ ) of each idea was given by:

$$n = \frac{1}{i} \times \sum_i \frac{\sum_j (w_j \times R_{ij})}{1} \quad (1)$$

where  $w_j$  represented the weight for the  $j$ th component (i.e., *what*, *how*, or *compound*). The recommended weights for *what*, *how*, or *compound* were 0.5, 0.3, and 0.2, respectively [15].  $R$  represented the rarity score of the  $j$ th component of  $i$ th sub-function. The overall rarity score of  $i$ th sub-function was given by the weighted average value of  $j$ th component in  $i$ th sub-function. The novelty score of each idea was given by unweighted average rarity scores of all sub-functions.  $R$  for each idea's solution was given by:

$$R = \frac{T - C}{T} \quad (2)$$

where  $T$  represented the total number of solutions for a given sub-function component, and  $C$  was the number of solutions of the same type as the current solution.

For example, an idea of a hammer-like stapler was intended to reduce effort for users (please see Table A1 in Appendix A). It got inspiration from the hammer and added a grip on the stapler for better grasping. This idea only provided one solution for the sub-function, "import human action or energy". The corresponding *what*, *how*, and *compound* were "hand", "grip", and "the hand grasping the grip on the stapler to staple papers". There were 19 solutions in total ( $T = 19$ ) for "import human action or energy". The number of solutions with the same *what*, *how*, or *compound* from all ideas were 19, 10, and 10, respectively (i.e.,  $C_{\text{what}} = 19$ ,  $C_{\text{how}} = 10$ , and  $C_{\text{compound}} = 10$ ). According to equation (2), rarity scores of *what*, *how*, or *compound* were 0.00, 0.47, and 0.47, respectively. According to equation (1) and recommended weights (0.5, 0.3, and 0.2 for *what*, *how*, or *compound*, respectively) [15], the novelty score of this idea was 0.24.

### 2.5. Procedure

We held a workshop of redesigning staplers for the participants. Before kicking off the workshop, we assessed participants' affective traits using Test of Divergent Feeling (see details in Section 2.3). In the workshop, we introduced several innovative cases of analogical reasoning (for example, Velcro), and provided each participant with the target, twenty-seven stimuli, and one worksheet (see details in Section 2.2). We first asked the participants to recall problems they had met when using the stapler. Then, we asked each participant to get inspiration from one stimulus. Next, we asked each participant to produce one idea for solving one problem. Participants were required to write down the selected stimulus, goals (e.g., "I wanted the stapler to need less effort for using"), and describe the idea in sketch and text. Participants were encouraged to think freely and focus on novelty. Participants were required to produce their ideas within an hour. After the workshop, we assessed the novelty of all ideas (see details in Section 2.4). These ideas were classified according to their goal intentions descriptions (see results in Section 3.1).

## 3. Results

### 3.1. Goals Identification and Classification

We identified five goals with different intentions, including effort-saving, versatility, orderliness, easy storage, and accuracy (see the list in Table 1; see examples of Table A1 in Appendix A). A total of 92.6% of these goals were effort-saving ( $N = 16$ ), versatility ( $N = 18$ ), and orderliness ( $N = 16$ ); 7.4% of them were easy storage ( $N = 2$ ) and accuracy ( $N = 2$ ).

**Table 1.** Goals and intentions.

Goals	Intentions	N
Saving effort or using the tool more easily	effort-saving	16
Meeting various needs in different situations, such as stapling large papers, hard papers, posters, or other non-paper materials	versatility	18
Keep things in order and remain stable to avoid confusion	orderliness	16
Making the stapler or staples be easier to store or carry	easy storage	2
Making it possible to measure and position accurately	accuracy	2

### 3.2. Affective Traits and Idea Assessment

Affective traits scores are shown in Table 2. The mean score of imagination was the highest ( $M = 30.76$ ,  $SD = 3.70$ ), followed by risk-taking ( $M = 29.74$ ,  $SD = 2.96$ ) and complexity ( $M = 27.46$ ,  $SD = 4.09$ ), and the mean score of curiosity was the lowest ( $M = 22.87$ ,  $SD = 2.13$ ). The idea novelty scores are shown in Table 3, ranging from 0.17 to 1.00 in total ( $Mean = 0.45$ ,  $SD = 0.23$ ). The mean novelty score of orderliness was the highest ( $M = 0.59$ ,  $SD = 0.19$ ), followed by easy storage ( $M = 0.49$ ,  $SD = 0.02$ ), versatility ( $M = 0.41$ ,  $SD = 0.26$ ) and effort-saving ( $M = 0.36$ ,  $SD = 0.21$ ), and the mean novelty score of accuracy was the lowest ( $M = 0.33$ ,  $SD = 0.24$ ).

**Table 2.** Affective traits scores.

Affective Traits	Scores					
	N	Mean	Mdn	SD	Min	Max
risk-taking	54	29.74	30.00	2.96	23.00	36.00
curiosity	54	22.87	23.00	2.13	19.00	27.00
imagination	54	30.76	30.00	3.70	23.00	38.00
complexity	54	27.46	27.50	4.09	19.00	35.00

**Table 3.** Novelty scores of ideas.

Goals Intentions	Novelty					
	N	Mean	Mdn	SD	Min	Max
effort-saving	16	0.43	0.42	0.24	0.17	0.89
versatility	18	0.35	0.24	0.24	0.17	0.93
orderliness	16	0.58	0.59	0.21	0.24	1.00
easy storage	2	0.50	0.50	0.00	0.50	0.50
accuracy	2	0.46	0.46	0.06	0.42	0.50
total	54	0.45	0.46	0.23	0.17	1.00

### 3.3. Hypotheses Testing

Because the number of ideas for easy storage and accuracy was too small to take into account, we ignored them and simply focused on the goals of effort-saving, versatility, and orderliness. Before testing hypotheses H2 and H3, we applied a multiple linear regression. The result showed that there was no interactive effect on novelty between affective traits and goal setting,  $F(17, 32) = 1.32$ ,  $p = 0.241$ ,  $R^2 = 0.41$ ,  $R^2_{\text{adjusted}} = 0.10$ .

#### 3.3.1. Affective Traits and Goals

Hypothesis H1 predicted that affective traits had an effect on goal setting. We first applied a one-way MANOVA test. Results showed no statistically significant difference among the four affective traits based on the three goals (effort-saving, versatility, and orderliness goals),  $F(8, 88) = 1.09$ ,  $p = 0.376$ , Wilk's  $\Lambda = 0.83$ . Then, we employed the one-way ANOVA test for the four affective traits, respectively. The Shapiro–Wilk test indicated that affective traits scores were approximately normally distributed ( $p$ -value ranged from

0.040 to 0.825). Levene's test reported that variances were homogenous ( $p$ -value ranged from 0.054 to 0.845). Figure 3 shows that there was a significant difference in risk-taking among the three goals,  $F_{\text{risk-taking}}(2, 47) = 3.74, p = 0.031, \eta^2 = 0.14$ . However, we found no significant difference in curiosity, imagination, or complexity among the three goals,  $F_{\text{curiosity}}(2, 47) = 1.86, p = 0.166, \eta^2 = 0.07$ ;  $F_{\text{imagination}}(2, 47) = 1.24, p = 0.298, \eta^2 = 0.05$ ;  $F_{\text{complexity}}(2, 47) = 0.80, p = 0.456, \eta^2 = 0.03$ . Post-hoc using the Tukey test showed that the mean risk-taking score of participants setting the versatility goal ( $M = 30.89$ ) was higher than that of the effort-saving goal ( $M = 29.56$ ); however, the difference was not significant ( $p = 0.312$ ). The mean risk-taking score of participants setting the versatility goal was higher than that of the orderliness goal ( $M = 28.44$ ) and the difference was significant ( $p = 0.024$ ). There was no significant difference in the mean risk-taking score between effort-saving and orderliness goal ( $p = 0.450$ ). The results showed participants with risk-taking tended to set the versatility goal. It indicated that only risk-taking impacted goal setting, which partially supported the hypothesis H1.

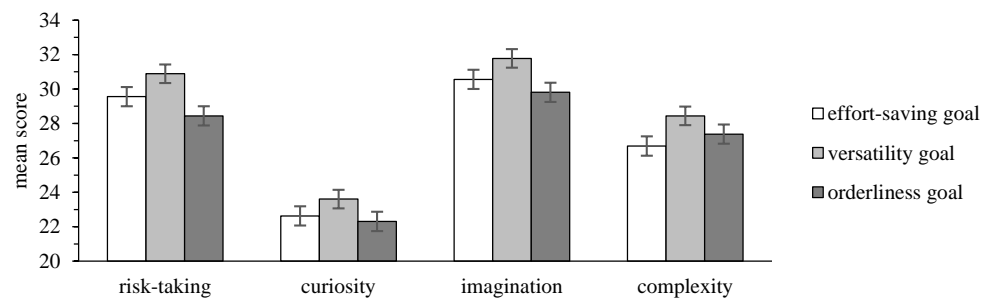


Figure 3. Error bars (95% CI) of affective traits scores.

### 3.3.2. Goal Setting and Novelty

Hypothesis H2 predicted that goals with different intentions had an effect on novelty. The Shapiro–Wilk test showed that novelty scores were not normally distributed for the effort-saving goal and versatility goal ( $W_{\text{effort-saving}} [16] = 0.82, p = 0.004$ ;  $W_{\text{versatility}} [18] = 0.77, p < 0.001$ ); novelty scores were normally distributed for orderliness goal ( $W_{\text{orderliness}} [16] = 0.96, p = 0.728$ ). Levene's test reported that variances were homogenous ( $p = 0.780$ ). We applied the Kruskal–Wallis test for the three goals. Figure 4 showed results that goals with different intentions had a significant effect on the novelty,  $H(2) = 9.82, p = 0.007$ . Post-hoc test using the Dunn–Bonferroni showed that the ideas' novelty score of the orderliness goal ( $Mdn = 0.59$ ) was higher than that of the effort-saving goal ( $Mdn = 0.42$ ), though it was not significant ( $p = 0.154$ ). The ideas' novelty score of the orderliness goal was significantly ( $p = 0.006$ ) higher than that of the versatility goal ( $Mdn = 0.24$ ). The ideas' novelty score of the effort-saving goal ( $Mdn = 0.42$ ) was insignificantly ( $p = 0.812$ ) higher than that of the versatility goal ( $Mdn = 0.24$ ). The results showed that the orderliness goal tended to have the highest novelty ideas, followed by the effort-saving goal and the versatility goal. To sum up, the above results showed that goals with different intentions had a significant effect on the novelty, which partially supported hypothesis H2.

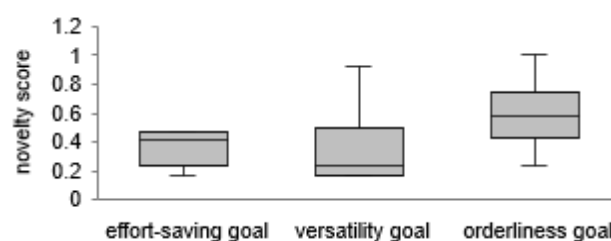


Figure 4. Box plot of mean novelty scores of effort-saving, versatility, and orderliness goals.

### 3.3.3. Affective Traits and Novelty

Hypothesis H3 predicted that affective traits had an impact on the novelty. We first analyzed the relationship between the affective traits and the novelty in total. The Shapiro–Wilk test indicated that the novelty scores were not normally distributed,  $W(54) = 0.90$ ,  $p < 0.001$ ). We also used the Spearman’s rho correlation coefficient. The results showed that risk-taking, curiosity, imagination, and complexity were not significantly related to the novelty (p-value ranged from 0.189 to 0.895). The results did not support hypothesis H3.

We then analyzed the relationship between the affective traits and the novelty for effort-saving goal, versatility goal, and orderliness goal, respectively. As mentioned in sub-Section 3.3.2, the Shapiro–Wilk test indicated that the novelty scores were not normally distributed for the effort-saving goal and versatility goal but normally distributed for orderliness goal. We used the Spearman’s rho correlation coefficient between the affective traits and the novelty for the three goals, respectively. For the effort-saving goal, there was a positive correlation between curiosity and novelty ( $r = 0.56$ ,  $p = 0.023$ ); but the risk-taking, imagination, and complexity were not significantly related to novelty (p-value ranged from 0.184 to 0.585). For the versatility goal, the risk-taking, curiosity, imagination, and complexity were not significantly related to novelty (p-value ranged from 0.810 to 0.936). For the orderliness goal, there was a positive correlation between complexity and novelty ( $r = 0.51$ ,  $p = 0.042$ ), yet the risk-taking, curiosity, and imagination were not significantly related to the novelty (p-value ranged from 0.575 to 0.670). The results showed positive correlations between curiosity and novelty with the effort-saving goal, as well as between the complexity and novelty with the orderliness goal. The results partially supported the hypothesis H3.

## 4. Discussion

This study aimed to explore the impact of goals and affective traits on positive creativity. We held a creativity workshop for fifty-four participants to redesign the given stapler. Before the training, we measured participants’ four affective traits, including the risk-taking, curiosity, imagination, and complexity. We provided them with twenty-seven analogical sources as inspirations and encouraged divergent thinking. Each participant was required to produce one idea for making the stapler better. We classified their goals into five types (i.e., effort-saving, versatility, orderliness, easy storage, and accuracy). The novelty of ideas was rated using a systematic method. Results showed three main findings:

- (1) Participants with high risk-taking scores tended to set the versatility goal;
- (2) Participants who set the orderliness goal tended to have the highest novelty ideas;
- (3) Positive correlations existed between the curiosity and novelty with the effort-saving goals, as well as between the complexity and novelty with the orderliness goals.

The first finding showed that risk-taking dominated the goal setting. This finding partially supported hypothesis H1 that affective traits had an effect on goal setting. That is to say, our research did not completely agree with such studies as James, Clark and Cropanzano [13] and James and Taylor [1]. Risk-taking refers to facing new challenges and dealing with various problems, especially in unknown situations [33,65]. In contrast, the versatility goal led to the pursuit of new ideas that meet various needs in different situations (e.g., the need to staple large-size paper, hard paper, posters, or other non-paper materials). We argued that the essence of the versatility goal was intrinsically related to risk-taking. The participants with high risk-taking were more inclined to face challenges, thereby setting the versatility goal to meet requirements in various situations.

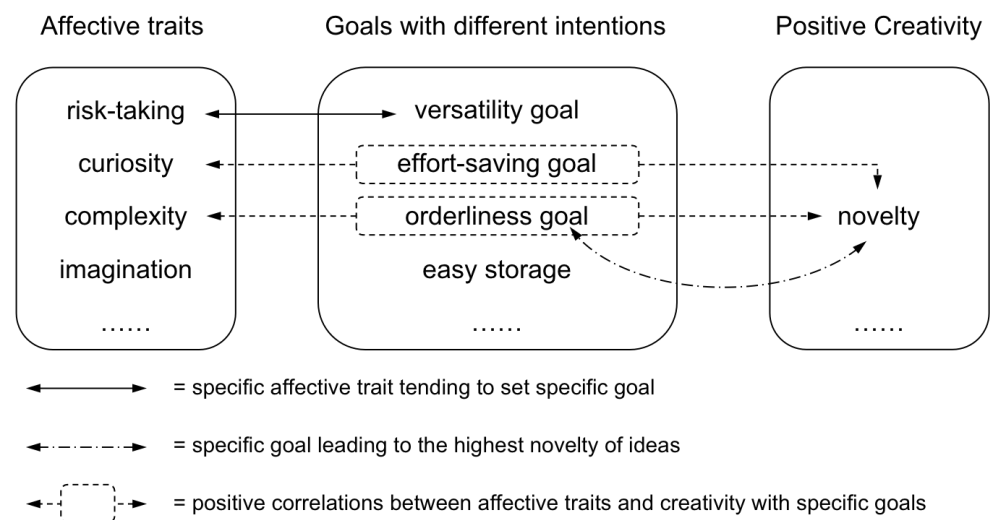
The second finding showed the advantage of orderliness goals on creativity. This finding supported the hypothesis H2 that the goals with different intentions determined the novelty. The orderliness goals intended to staple papers stably and orderly to avoid chaos. In other words, the participants intended to make an order from the chaos. It was consistent with the view that disorder can promote unconventional thinking and creativity [66]. Besides, the affective traits scores of the participants who set the orderliness



goals were not significantly higher than others. This indicated that the orderliness goals were applicable for most of the participants.

Interestingly, we observed that the goals played a role in bridging affective traits and positive creativity, respectively, as shown in the third finding. This finding partly supported the hypothesis H3 that affective traits determined novelty. This finding was contrary to the literature reporting that affective traits generally do not reflect current creative abilities [31,32]. Nevertheless, it supported the literature claiming that direct relationships exist between affective traits and creativity [27]. The relationship between the goals and motivation can explain this finding. Goals can activate and guide motivation [13], while motivation provides the energy for innovation [1]. Curiosity is a kind of positive motivation associated with exploration and seeking novelty [35,37,38,67]. In our workshop, the participants' effort-saving goals activated their curiosity. The higher curiosity, in turn, drove the participants to produce more creative ideas for saving efforts. In addition, the complexity positively correlated with the novelty for the orderliness goals. Complexity refers to the quality of sorting out clues and developing solutions for complex or chaotic problems [33]. We argued that the complexity was essentially related to the orderliness goal for putting complicated things in order. Therefore, the participants with high complexity produced better ideas for orderliness goals.

We summarized three kinds of relationships between affective traits, goals, and creativity (Figure 5), including (1) specific affective traits tending to set specific goals; (2) specific goals leading to the highest novelty of ideas; (3) positive correlations between affective traits and creativity with specific goals. In particular, Figure 5 showed that goals associated affective traits with positive creativity.



**Figure 5.** Relationships between affective traits, goals, and creativity.

We suggest that future teaching for positive creativity should focus on students' affective traits and guide them to set goals. We summarize the following guidelines for teaching positive creativity:

- (1) The teacher should help the student identify the real needs and ignore the unimportant desires or wants, and help them set a concise goal to meet the real needs. In our workshop, for example, effort-saving, versatility, and orderliness were identified as major needs, while easy storage and accuracy were thought unimportant.
- (2) Considering students' differences in affective traits, the teacher should encourage them to set effective goals to ensure the novelty of ideas generated. The workshop revealed that some relationships between affective traits and goals could better result in creative ideas. For example, the relationships such as high risk-taking with a versatility goal, the high curiosity with an effort-saving goal, and the high complexity

or moderate affective traits in general with an orderliness goal, tended towards high novelty.

Several limitations in the current study remained. First, we only focused on novelty in creativity, for novelty is the most representative indicator of creativity [12]. Future work should consider other aspects of creativity. Second, although the imagination also has importance in creativity [39], we did not find any well-defined relationships between the imagination and the goal setting or creativity. Our straightforward training using structured worksheets might limit the participants' creativity performance. Future research should develop more complicated training programs to avoid this limitation. Finally, the role of the unimportant goals in creating ideas was unclear. For instance, in the stapler redesign workshop, we treated easy storage and accuracy as the unimportant goals because of their rarity. It could be paradoxical that the rarity of a certain need simply implied its uniqueness and the potential to generate creative ideas. Therefore, the identification of the common and uncommon needs is needed in future work.

## 5. Conclusions

Goals played a bridging role between affective traits and creativity. This role was reflected in that (1) when the goal intention was saving the effort or using the tool more easily (i.e., effort-saving goal), participants with high curiosity generated ideas with high novelty; (2) when the goal intention was keeping things in order and remaining stable to avoid confusion (i.e., orderliness goal), participants with high complexity generated ideas with high novelty. In addition, we found participants with high risk-taking tended to set versatility goals, implementing various needs in different situations; the orderliness goal led to the highest novelty of ideas. Our findings are valuable for positive creativity teaching. Affective traits influence students' goal setting and their creativity in problem-solving. Paying attention to affective traits can better guide students towards positive goals and foster their creativity. These findings can be applied to some fields, such as design creativity and positive creativity education. For example, when teachers train students' creativity in problem-solving, they can first evaluate students' affective traits, and then assign appropriate goals to students according to their affective traits. Future work will explore relationships between other aspects of personal traits (e.g., flexibility and elaboration), different goals (e.g., efficiency improvement), and other factors of creativity (e.g., feasibility and usefulness).

**Author Contributions:** Conceptualization, H.-H.W. and X.D.; methodology, H.-H.W. and X.D.; software, X.D.; validation, X.D.; formal analysis, X.D.; investigation, X.D.; resources, X.D.; data curation, X.D.; writing—original draft preparation, X.D.; writing—review and editing, H.-H.W.; visualization, X.D.; supervision, H.-H.W.; project administration, H.-H.W.; funding acquisition, H.-H.W. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by Teaching Practice Research of Ministry of Education, Republic of China (Taiwan) under grant number PHA1100858.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

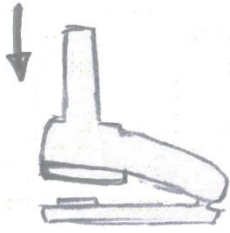
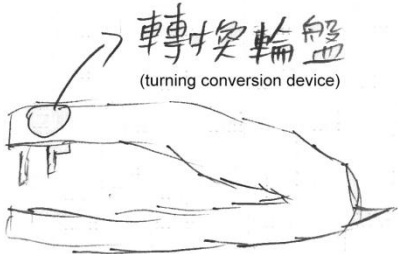
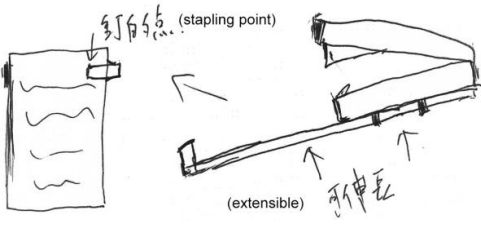
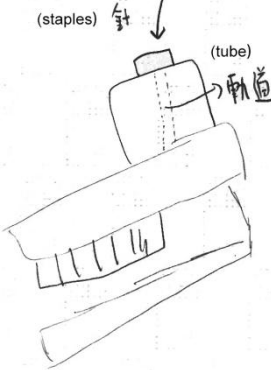
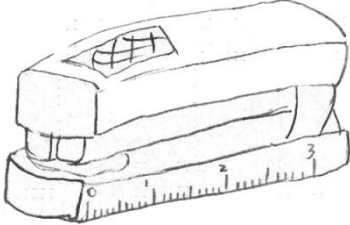
**Data Availability Statement:** Not applicable.

**Acknowledgments:** The authors thank all who contributed to the study and the support of National Taipei University of Technology. The authors sincerely thank Editor-in-chief and reviewers for their kind and constructive comments which led to substantial improvements of this paper.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

Table A1. Examples of ideas for different goal intentions.

Intention	Sketch	Description
effort-saving		The idea is inspired by the hammer and developed to reduce effort for users. This stapler has a grip on the top for better grasping.
versatility		The idea is inspired by the plug adapter and developed to staple different shapes of paper. This stapler has a turning conversion device to change the stapling style for different shapes of paper.
orderliness		The idea is inspired by the c-clip and developed to staple documents in an orderly fashion. This new stapler can align and hold the documents with a straight strip at the bottom.
easy storage		The idea is inspired by the bucket tool organizer and was developed to make its storage easier. This stapler has a device with a hollow tube on the top, which can store staples and guide them to be installed automatically.
accuracy		The idea is inspired by the tape measure and developed to measure things, as an additional function, by using the scale printed on the side.

## References

1. James, K.; Taylor, A. Positive Creativity and Negative Creativity (and Unintended Consequences). In *The Dark Side of Creativity*; Cropley, D.H., Cropley, A.J., Kaufman, J.C., Runco, M.A., Eds.; Cambridge University Press: New York, NY, USA, 2010; pp. 33–56.
2. Reiter-Palmon, R. Are the outcomes of creativity always positive? *Creat. Theor. Res. Appl.* **2019**, *5*, 177. [[CrossRef](#)]
3. Sternberg, R.J. Positive Creativity. In *Positive Psychology: An International Perspective*; Kostic, A., Chadee, D., Eds.; John Wiley & Sons: Hoboken, NJ, USA, 2021; pp. 33–42.

4. Sternberg, R.J.; Chowkase, A. When We Teach for Positive Creativity, What Exactly Do We Teach For? *Educ. Sci.* **2021**, *11*, 237. [[CrossRef](#)]
5. Torrance, E.P. Teaching for creativity. *Front. Creat. Res. Beyond Basics* **1987**, *189*, 215.
6. McWilliam, E.; Dawson, S. Teaching for creativity: Towards sustainable and replicable pedagogical practice. *High. Educ.* **2008**, *56*, 633–643. [[CrossRef](#)]
7. Kaplan, D.E. Creativity in education: Teaching for creativity development. *Psychology* **2019**, *10*, 140–147. [[CrossRef](#)]
8. Shalley, C.E. Effects of productivity goals, creativity goals, and personal discretion on individual creativity. *J. Appl. Psychol.* **1991**, *76*, 179–185. [[CrossRef](#)]
9. Russ, S.W. *Affect and Creativity: The Role of Affect and Play in the Creative Process*; Lawrence Erlbaum Associates Inc.: Hillsdale, NJ, USA, 1993.
10. Shalley, C.E.; Koseoglu, G. Goals and Creativity. In *New Developments in Goal Setting and Task Performance*; Locke, E.A., Latham, G.P., Eds.; Routledge: New York, NY, USA, 2013; pp. 367–380.
11. Brem, A. Creativity on Demand: How to Plan and Execute Successful Innovation Workshops. *IEEE Eng. Manag. Rev.* **2019**, *47*, 94–98. [[CrossRef](#)]
12. Dean, D.L.; Hender, J.; Rodgers, T.; Santanen, E. Identifying good ideas: Constructs and scales for idea evaluation. *J. Assoc. Inf. Syst.* **2006**, *7*, 646–699.
13. James, K.; Clark, K.; Cropanzano, R. Positive and negative creativity in groups, institutions, and organizations: A model and theoretical extension. *Creat. Res. J.* **1999**, *12*, 211–226. [[CrossRef](#)]
14. Peeters, J.; Verhaegen, P.A.; Vandevenne, D.; Dufloy, J. Refined metrics for measuring novelty in ideation. In Proceedings of the IDMME Virtual Concept Research in Interaction Design, Bordeaux, France, 20–22 October 2010; pp. 20–22.
15. Fu, K.K.; Chan, J.; Cagan, J.; Kotovsky, K.; Schunn, C.; Wood, K. The meaning of “near” and “far”: The impact of structuring design databases and the effect of distance of analogy on design output. *J. Mech. Des.* **2013**, *135*. [[CrossRef](#)]
16. Lenau, T.A.; Keshwani, S.; Chakrabarti, A.; Ahmed-Kristensen, S. Biocards and level of abstraction. In Proceedings of the 20th International Conference on Engineering Design: Design for Life, Milan, Italy, 27–30 July 2015.
17. Cropley, D.H.; Kaufman, J.C.; Cropley, A.J. Malevolent creativity: A functional model of creativity in terrorism and crime. *Creat. Res. J.* **2008**, *20*, 105–115. [[CrossRef](#)]
18. Kaspi-Baruch, O. Big Five personality and creativity: The moderating effect of motivational goal orientation. *J. Creat. Behav.* **2019**, *53*, 325–338. [[CrossRef](#)]
19. Hennessey, B.A. Motivation and Creativity. In *The Cambridge Handbook of Creativity*, 2nd ed.; Kaufman, J.C., Sternberg, R.J., Eds.; Cambridge University Press: Cambridge, UK, 2019; pp. 374–395.
20. Malik, M.A.R.; Choi, J.N.; Butt, A.N. Distinct effects of intrinsic motivation and extrinsic rewards on radical and incremental creativity: The moderating role of goal orientations. *J. Organ. Behav.* **2019**, *40*, 1013–1026. [[CrossRef](#)]
21. Williams, S.D. Personality, attitude, and leader influences on divergent thinking and creativity in organizations. *Eur. J. Innov. Manag.* **2004**, *7*, 187–204. [[CrossRef](#)]
22. Feist, G.J. The Function of Personality in Creativity: Updates on the Creative Personality. In *The Cambridge Handbook of Creativity*, 2nd ed.; Kaufman, J.C., Sternberg, R.J., Eds.; Cambridge University Press: Cambridge, UK, 2019; pp. 353–373.
23. Bouiri, O.; Lotfi, S.; Talbi, M. Correlative study between personality traits, student mental skills and educational outcomes. *Educ. Sci.* **2021**, *11*, 153. [[CrossRef](#)]
24. Claxton, A.F.; Pannells, T.C.; Rhoads, P.A. Developmental trends in the creativity of school-age children. *Creat. Res. J.* **2005**, *17*, 327–335. [[CrossRef](#)]
25. Srivastava, S.; Childers, M.E.; Baek, J.H.; Strong, C.M.; Hill, S.J.; Warsett, K.S.; Wang, P.W.; Akiskal, H.S.; Akiskal, K.K.; Ketter, T.A. Toward interaction of affective and cognitive contributors to creativity in bipolar disorders: A controlled study. *J. Affect. Disord.* **2010**, *125*, 27–34. [[CrossRef](#)] [[PubMed](#)]
26. Williams, F.E. Models for encouraging creativity in the classroom by integrating cognitive-affective behaviors. *Educ. Technol.* **1969**, *9*, 7–13.
27. Amabile, T.M.; Barsade, S.G.; Mueller, J.S.; Staw, B.M. Affect and creativity at work. *Adm. Sci. Q.* **2005**, *50*, 367–403. [[CrossRef](#)]
28. Stoermer, S.; Luring, J.; Selmer, J. The effects of positive affectivity on expatriate creativity and perceived performance: What is the role of perceived cultural novelty? *Int. J. Intercult. Relat.* **2020**, *79*, 155–164. [[CrossRef](#)]
29. Dackert, I. Creativity in teams: The impact of team members’ affective well-being and diversity. *Open, J. Soc. Sci.* **2016**, *4*, 19–28. [[CrossRef](#)]
30. Hammershøj, L.G. Conceptualizing creativity and innovation as affective processes: Steve Jobs, Lars von Trier, and responsible innovation. *Philos. Manag.* **2018**, *17*, 115–131. [[CrossRef](#)]
31. Jauk, E.; Benedek, M.; Neubauer, A.C. The road to creative achievement: A latent variable model of ability and personality predictors. *Eur. J. Personal.* **2014**, *28*, 95–105. [[CrossRef](#)]
32. Runco, M.A. Commentary: Divergent thinking is not synonymous with creativity. *Psychol. Aesthet. Creat. Arts* **2008**. [[CrossRef](#)]
33. Williams, F.E. *Creativity Assessment Packet: CAP*; Pro-Ed: Dallas, TX, USA, 1993.

34. Attanasi, G.; Curci, Y.; Llerena, P. *Looking at Creativity from East to West: Risk Taking and Intrinsic Motivation in Socially and Culturally Diverse Countries*; Bureau d'Economie Théorique et Appliquée: Strasbourg, France, 2019.
35. Kashdan, T.B.; Silvia, P.J. Curiosity and Interest: The Benefits of Thriving on Novelty and Challenge. In *Oxford Handbook of Positive Psychology*; Snyder, C.R., Lopez, S.J., Eds.; Oxford University Press: New York, NY, USA, 2009; pp. 367–374.
36. Silvia, P.J. Curiosity and Motivation. In *The Oxford Handbook of Human Motivation*; Ryan, R., Ed.; Oxford University Press: New York, NY, USA, 2012; pp. 157–166.
37. Gross, M.E.; Zedelius, C.M.; Schooler, J.W. Cultivating an understanding of curiosity as a seed for creativity. *Curr. Opin. Behav. Sci.* **2020**, *35*, 77–82. [[CrossRef](#)]
38. Schutte, N.S.; Malouff, J.M. A meta-analysis of the relationship between curiosity and creativity. *J. Creat. Behav.* **2020**, *54*, 940–947. [[CrossRef](#)]
39. Gaut, B. Creativity and imagination. *Creat. Art* **2003**, *6*, 148–173.
40. Gotlieb, R.J.; Hyde, E.; Immordino-Yang, M.H.; Kaufman, S.B. Imagination is the Seed of Creativity. In *The Cambridge Handbook of Creativity*, 2nd ed.; Kaufman, J.C., Sternberg, R.J., Eds.; Cambridge University Press: Cambridge, UK, 2019; pp. 709–731.
41. Locke, E.A.; Latham, G.P. Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *Am. Psychol.* **2002**, *57*, 705–717. [[CrossRef](#)] [[PubMed](#)]
42. Locke, E.A.; Latham, G.P. *Goal Setting Theory*, 1990. In *New Developments in Goal Setting and Task Performance*; Locke, E.A., Latham, G.P., Eds.; Routledge: New York, NY, USA, 2013; pp. 4–15.
43. Sternberg, R.J.; Karami, S. An 8P theoretical framework for understanding creativity and theories of creativity. *J. Creat. Behav.* **2021**. [[CrossRef](#)]
44. Shalley, C.E. Effects of coaction, expected evaluation, and goal setting on creativity and productivity. *Acad. Manag. J.* **1995**, *38*, 483–503. [[CrossRef](#)]
45. Gollwitzer, P.M. Goal achievement: The role of intentions. *Eur. Rev. Soc. Psychol.* **1993**, *4*, 141–185. [[CrossRef](#)]
46. Korchagina, G.I.; Ivutina, E.P.; Derisheva, V.A.; Bogodukhova, E.M.; Lavrik, O.V.; Dubrovina, D.A. Goal-setting as a metacognitive ability of personality. *J. Environ. Treat. Tech.* **2019**, *7*, 1234–1241.
47. Gust, H.; Krumnack, U.; Kühnberger, K.-U.; Schwering, A. Analogical reasoning: A core of cognition. *Künstliche Intell.* **2008**, *22*, 8–12.
48. Hofstadter, D. *Epilogue: Analogy as the Core of Cognition*; Gentner, D., Holyoak, K., Kokinov, B., Eds.; The MIT Press: London, UK, 2001; Volume 15, pp. 499–538.
49. Vosniadou, S. *Analogical Reasoning as a Mechanism in Knowledge Acquisition: A Developmental Perspective*; Center for the Study of Reading Technical Report; no. 438; University of Illinois at Urbana-Champaign: Champaign, IL, USA, 1988.
50. Gentner, D.; Brem, S.; Ferguson, R.; Wolff, P. Analogy and creativity in the works of Johannes Kepler. *Creat. Thought Investig. Concept. Struct. Process.* **1997**, 403–459. [[CrossRef](#)]
51. Salvucci, D.D.; Anderson, J.R. Integrating analogical mapping and general problem solving: The path-mapping theory. *Cogn. Sci.* **2001**, *25*, 67–110. [[CrossRef](#)]
52. Goel, A.K. Design, analogy, and creativity. *IEEE Expert* **1997**, *12*, 62–70. [[CrossRef](#)]
53. Stevens, L.; De Vries, M.M.; Bos, M.M.; Kopnina, H. Biomimicry Design Education Essentials. In Proceedings of the 22nd International Conference on Engineering Design (ICED19), Delft, The Netherlands, 5–8 August 2019; pp. 459–468.
54. Podoynitsyna, K.; Snihur, Y.; Thomas, L.D.; Grégoire, D.A. Creating Meta-Narratives: How Analogies and Metaphors Support Business Model Innovation. In *Business Models and Cognition*; Sund, K.J., Galavan, R.J., Bogers, M., Eds.; Emerald Publishing Limited: Bingley, UK, 2020; Volume 4, pp. 135–167.
55. Çubukcu, E.; Dündar, Ş.G. Can creativity be taught? An empirical study on benefits of visual analogy in basic design education. *A | Z ITU J. Fac. Archit.* **2007**, *4*, 67–80.
56. Kao, C.-Y. How Figurativity of Analogy Affects Creativity: The Application of Four-Term Analogies to Teaching for Creativity. *Think. Ski. Creat.* **2020**, *36*, 100653. [[CrossRef](#)]
57. Linsey, J.S.; Markman, A.; Wood, K. Design by analogy: A study of the WordTree method for problem re-representation. *J. Mech. Des.* **2012**, *134*, 041009. [[CrossRef](#)]
58. Kurniawati, L.; Farhana, I.; Miftah, R. Improving students' mathematical intuitive thinking ability using analogy learning model. *J. Phys. Conf. Ser.* **2022**, *2157*, 012042. [[CrossRef](#)]
59. Farzaneh, H.H.; Lindemann, U. *A Practical Guide to Bio-Inspired Design*; Springer: Berlin/Heidelberg, Germany, 2018.
60. Fayemi, P.-E.; Wanieck, K.; Zollfrank, C.; Maranzana, N.; Aoussat, A. Biomimetics: Process, tools and practice. *Bioinspir. Biomim.* **2017**, *12*, 011002. [[CrossRef](#)] [[PubMed](#)]
61. Lenau, T.A.; Metze, A.-L.; Hesselberg, T. Paradigms for Biologically Inspired Design. In *Bioinspiration, Biomimetics, and Bioreplication VIII*; SPIE—International Society for Optical Engineering: Denver, CO, USA, 2018; p. 1059302. [[CrossRef](#)]
62. Sancibrian, R.; Gonzalez-Sarabia, E.; San-José, J.; Llata, J.; Larrauri, M. Design by Analogy in Engineering Education: A Method to Improve Creative Ideas. In Proceedings of the 13th International Technology, Education and Development Conference, Valencia, Spain, 11–13 March 2019; pp. 6268–6274.
63. Lin, S.; Wang, M. *Creativity Assessment Packet (Taiwan Edition)*; Psychological Publishing Co., Ltd.: Taipei, Taiwan, 1994.

64. Hirtz, J.; Stone, R.B.; McAdams, D.A.; Szykman, S.; Wood, K.L. A functional basis for engineering design: Reconciling and evolving previous efforts. *Res. Eng. Des.* **2002**, *13*, 65–82. [[CrossRef](#)]
65. Treffinger, D.J.; Young, G.C.; Selby, E.C.; Shepardson, C. Assessing Creativity: A Guide for Educators. *Natl. Res. Cent. Gift. Talent.* **2002**, 121.
66. Vohs, K.D.; Redden, J.P.; Rahinel, R. Physical order produces healthy choices, generosity, and conventionality, whereas disorder produces creativity. *Psychol. Sci.* **2013**, *24*, 1860–1867. [[CrossRef](#)] [[PubMed](#)]
67. Hagtvedt, L.P.; Dossinger, K.; Harrison, S.H.; Huang, L. Curiosity made the cat more creative: Specific curiosity as a driver of creativity. *Organ. Behav. Hum. Decis. Process.* **2019**, *150*, 1–13. [[CrossRef](#)]