

The Impact of Stimuli Characteristics on the Ideation Process: An Evaluation of the Change of Perspective ‘Analogy’

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Abstract

Idea generation techniques provide a variety of approaches for supporting an innovation process. Until recently, the space of techniques has been unstructured, and no clear guidelines have been available for the selection of an appropriate technique for a given innovation goal. We used the ‘change of perspective’ paradigm as an approach to study idea generation techniques with the aim of obtaining more structured and rigorous guidelines for generating ideas.

This paper reports the results of an experiment that analysed the influence of the external stimuli characteristics on the idea generation. We introduce a new approach to characterise external stimuli for the change of perspective ‘analogy’ by using the criteria ‘typical’ and ‘relevant’. Twenty-two people used the change of perspective ‘analogy’ in an ideation workshop with a set of different external stimuli. The result supports our assumption that the characteristic of an external stimulus affect the generation of ideas.

1. Introduction

In a world of rapid change, the ability to generate innovative products and services is essential for any organisation to maintain its competitive position. Unfortunately, this ability is limited by the expertise of the organisation’s employees. In order to use synergy effects, organisations implement innovation processes to combine the expertise of their employees. These multi-stage processes combine a variety of techniques and methods to analyse the market situation, define strategic goals, and generate and implement ideas.

A weak link in the innovation process is the pre-development phase, often called the ‘front end of innovation’, which ranges from the generation of an idea to either its approval for development or its termination [12]. Because organisations may have different innovation goals—such as incremental or platform innovations—the ideation phase needs to be

capable of generating goal-oriented ideas. Organisations can increase the probability of obtaining goal-oriented ideas by conducting ideation workshops which combine different methods, so-called idea generation techniques for systematically supporting ideation.

Up to now, more than one hundred idea generation techniques have been published [13, 25, and 26]. Each of them provides a sequence of simple questions or instructions to support a group or an individual in an ideation process. Authors have used a variety of approaches to characterize and classify these techniques [15, 25, and 26]. However, no clear guidelines have been available for the selection and combination of appropriated idea generation techniques for a given strategic goal. As a result, organisations need experience for the design of ideation workshops.

In order to simplify the design of appropriate ideation workshops, we introduced the ‘change of perspective’ paradigm as an approach to design and classify idea generation techniques [15]. A change of perspective is defined as the underlying cognitive principle of an idea generation technique that stimulates the ideation process. This stimulation is done by using external stimuli to activate larger areas of the knowledge network of an individual, which would not be activated by an associative process. Change of perspective distinguishes three cognitive principles: ‘analogy’, ‘provocation’, and ‘random’, which can each be defined by a sequence of formal steps. We think that this formalisation can be used to define guidelines for the selection of an appropriate idea generation technique for a given strategic goal.

This paper presents the results of an experiment that analysed the influence of the external stimuli characteristics on the outcome of the change of perspective ‘analogy’. We will introduce a new approach to characterise external stimuli for ‘analogy’ by using the criteria ‘typical’ and ‘relevant’, and we will argue how this characterisation can be used to improve the efficiency of idea generation techniques using ‘analogy’

2. A creative cognition approach

Like Mednick [17], we see the creative process as the exploration and transformation of conceptual spaces of an individual to generate new ideas. In terms of a comprehensive understanding of this creative process, Lubart [16] accentuates the need for the specification of fundamental sub-processes of an individual. Researchers use cognitive models to specify and study these cognitive processes and their application to existing knowledge structures for the generation of ideas. A variety of cognitive models for creativity have been developed [3, 18, 19, and 23]. For example, the geneplore model [3] specified a creative process as a combination of generative processes (such as knowledge retrieval, idea association, synthesis, transformation and analogical transfer) to construct loosely formulated ideas, and explorative processes (such as interpretation and hypothesis testing) to elaborate and examine these ideas.

In our research, we used a cognitive model, called ‘search for ideas in associative memory’ (SIAM) [19] to analyse the underlying fundamental principles of idea generation techniques and the resulting cognitive processes of an individual. This model is based on Raaijmakers and Shiffrin’s [21] model of memory retrieval, which rests on a foundation of standard cognitive psychology assumptions.

SIAM assumes two memory systems: the long-term memory (LTM) and the working memory (WM). The LTM is an unlimited storage system, which is used to store previously acquired knowledge. Knowledge is stored as a richly interconnected network with numerous levels, categories and associations. This network is partitioned into images: knowledge structures that consist of a central concept and a number of features of that concept or associations with that concept. For example, the concepts ‘employee’, ‘department’, ‘lab’, ‘warehouse’, ‘product’ and ‘service’ may be grouped together into the image called ‘organisation’. Images have fuzzy boundaries, may overlap to a considerable degree, and have mutual associations. For example the concept ‘lab’ of the image ‘organisation’ is also strongly associated to the images for ‘university’, ‘science’ and ‘pharmacy’. The strength of a link may be due to the frequency of its traversal, or to the relatedness among the images that it connects [1]. The WM has limited capacity and functions as a temporary storage system. Individuals use the WM to execute conscious operations, such as rehearsal, recognition and decision making.

Based on SIAM, the creative process can be described as an associative process that proceeds in

two stages [19]. In the first stage, the individual retrieves knowledge from LTM by using a search cue. This search cue is generated in the WM by external stimuli that are received through the five senses of the individual. Which images in the LTM will be activated is depended on the cue and probabilistic. The activated image will be temporarily stored in the WM, after which the concepts and associations of that image become accessible.

In the second stage, the activated knowledge is used in the WM to generate ideas. Therefore, the individual forms new associations by combining the concepts of the image with one another or with elements of the search cue. The generation stage will be terminated, if the individual gets the impression that the application of basic cognitive processes to activated knowledge structures only leads to few additional ideas. In this case, the individual will go back to the first stage and activate a new image by generating a new search cue.

Without any external stimuli, the individual will modify the search cue by adding previously generated ideas or activated knowledge. Thus, the activated knowledge areas will be semantically related to each other. As a result, the likelihood of forming new associations between previously unrelated images decreases and only a small area of the solution space will be considered [9 and 17].

Idea generation techniques provide external stimuli by simple questions or instructions to enhance the performance of the creative process [23]. More than one-hundred idea generation techniques have been published, which provide a variety of approaches to generate and use haptic, visual or acoustic stimuli during the cognitive processes of an individual. In the next section, we present the ‘change of perspective’ paradigm as new approach to describe the fundamental principles of idea generation techniques and argue how it can be used to examine the influence of stimuli characteristics on the creative process.

3. The change of perspective

According to SIAM, the uses of external stimuli during the creative process lead the individual to different areas of their knowledge networks. Idea generation techniques provide a sequence of simple questions or instructions to support a group or an individual in a creative process. Thus, external stimuli can be predefined by the technique or will be generated by the individual itself by using the predefined instructions. By using stimuli, the individual could retrieve knowledge from different areas of their knowledge networks which could

provide new perspectives on a given creative task. These perspectives can be used to combine concepts of semantically unrelated images to creative solutions which could cover larger areas of the possible solution space as solutions resulting from a creative process with no external stimuli. As a result, we see the use of external stimuli as a basic requirement for an idea generation technique to help the individual to leave well-trodden thought paths and overcome occupational blindness. We call this mental principle of an idea generation technique a ‘change of perspective’. By definition, a change of perspective is a mental principle which uses external stimuli to activate areas of the knowledge network of an individual, which would only be activated in an unguided associative process at random [15].

In order to gain a theoretical understanding of the different ways how stimuli influence the creative process, we have analysed well-known idea generation techniques with regard to their change of perspective [15]. We discovered that the underlying principles involved can be mapped onto just four abstract principles. One of these principles did not generate a change of perspective by definition and uses knowledge of the given creative task to generate ideas. This principle is:

- ‘Brainstorming’ - to use knowledge of the given creative task as stimuli. Concepts of the creative task will be combined to new associations and used to generate new ideas for the creative task.

Three principles create a change of perspective by modifying the given associations in the knowledge network or activating unrelated knowledge areas to the creative task. These principles are:

- ‘Analogy’ - to search for similar situations to create a change of perspective. Knowledge about these analogous situations will be collected and used to generate ideas for the creative task.
- ‘Random’ - to use random elements to create a change of perspective. The characteristic knowledge of the random element will be transferred to the creative task. Resulting consequences or processes for the given creative task will be collected and used to generate ideas for the creative task.
- ‘Provocation’ - to challenge the characteristic knowledge of the creative task to create a change of perspective. Resulting consequences or processes for the given creative task will be collected and used to generate ideas for the creative task.

4. Ideation using external stimuli

We use these abstract principles to classify idea generation techniques with regard to their resulting change of perspective and to analyse the cognitive processes of an individual during their use [15]. We discovered that the underlying principles use external stimuli in a different way to activate knowledge for ideation. We discriminate between three types of use of external stimuli:

- ‘Pumping’ - to use external stimuli to change the focus of an association process onto specific concepts within the image of the creative task (we pump specific knowledge areas). For example ‘Brainstorming’ uses external stimuli to strengthen the relatedness among concepts and the image of the creative task. These concepts will be used by the individual in an associative process to activate knowledge areas which may overlap to a considerable degree with the image of the creative task.
- ‘Jumping’ - to use external stimuli to activate distant knowledge areas that have no or only a weak association to the image of the creative task (we jump to a distant location in the associative network). For example the principles ‘analogy’ and ‘random’ show similarities to the use of this type of stimuli. Both principles interrupt the association chain by external stimuli and activate distant knowledge areas. The principle ‘analogy’ uses concepts of the creative task as stimuli for knowledge retrieval. This will increase the probability that the activated image shares concepts with the image of the creative task. The principle ‘Random’ uses random elements as stimuli to retrieve knowledge that will be weakly associated to the image of the creative task.
- ‘Dumping’ - to use external stimuli to challenge the assumptions contained in the creative task (we discard or dump an assumption). For example ‘Provocation’ uses external stimuli to challenge the existing relationships between the image and concept of the creative task. The individual uses the resulting situation to activate knowledge that has no or only a weak association to the image of the creative task.

Different studies have analysed the influence of external stimuli on the idea generation process. Hender, Dean, Rodgers and Nunamaker Jr. [11] analysed the productivity of different idea generation techniques; using the underlying principles ‘brainstorming’, ‘analogy’ and ‘provocation’. The experiment results have shown that the underlying principle of an idea generation technique and the external stimuli used influence the productivity of the technique. Santanen, Briggs and de Vreede [24] compared two idea generation techniques that use the mental principle ‘Brainstorming’ with regard to the

creative score of the solutions generated and the concentration of creative solutions. One of these techniques uses external stimuli to support the ideation process. According to the experiment description, these stimuli provide different ways to think about the given creative task, similar to the principle ‘Pumping’. The authors argue that the use of external stimuli can support the generation of solutions with higher average creativity rating, and higher concentration of creative solutions compared to using no stimuli.

From the literature review, our conclusion is that the productivity of an idea generation technique varies in relation to the stimuli used and the knowledge retrieved. Not every image provides a starting point for the generation of a creative solution. However, we have not been able to find any discussion in the popular or scientific literature of what characterizes a good stimulus and how it influences the mental process of an individual. Most of the idea generation techniques that use stimuli are generic. They are presented in a general form; using predefined stimuli or formal descriptions to generate stimuli before or during their execution. It often remains unclear if the stimuli used are appropriate to support the ideation process for a given creative goal. We see this as a gap between research and practice. To gain further insight about the influence of external stimuli on idea generation techniques, we investigate the research question:

How do the characteristics of an external stimulus affect the generation of ideas?

In this paper, we present an approach to characterise external stimuli for idea generation techniques using the change of perspective ‘analogy’. In the next section, we will give an overview of current research on analogical thinking.

5. Ideation using analogical thinking

Over several decades, a variety of studies have analysed analogical thinking as a cognitive mechanism, in which the individual transfers information from similar situations or problems and uses it to generate ideas [3, 5, 6, and 20]. Research describes analogical thinking as a multistage process [2]. Confronted with a creative task, an individual searches in memory to access useful information. This process will terminate when activating knowledge with an analogical connection to the creative task. An analogical connection is given, if some basic elements of the creative task and the analogous situation are similar. The individual will

map corresponding parts of the analogy and the creative task onto each other, and finally apply the transferred knowledge to generate ideas.

Dahl and Mourau [2] describe the similarity between the analogy and the creative task on a continuum from ‘near’ analogies to ‘far’ analogies. They argue that near analogies are more easily identified than far analogies. Near analogies have ‘literal similarities’ [8] and present smaller conceptual distances, while far analogies typically require the identification of similarities in the relational structure between the creative task and the analogy. Regarding to the innovation process, near analogies share the same or a close conceptual domain with the creative task, which would probably support the generation of incremental innovations. On the other hand, far analogies serve as the basis for ‘mental leaps’ which could support the generation of radical innovations [14]. However, research argues that the identification of analogies typically depends on the cognitive abilities and the personal experience of an individual [2, 7, and 22]. Individuals can only activate analogies whose elements were already associated by the individual to the creative task [10]. Gassmann and Zeschky [4] have analysed the use of analogical thinking in product innovation. The authors found that organisations only identify far analogies by abstracting the creative task to its structural relationships. Thus, the abstraction process requires a deep understanding of the creative task; for example the function and the interrelation between single components of a product, and its context which focuses on the customer benefits.

One approach to support the individual during analogical thinking is given by idea generation techniques which using the change of perspective ‘analogy’. The underlying principle ‘analogy’ can be formalised by the following sequence of steps:

- Step 1: *Select statements of the creative task.*
- Step 2: *Find analogous situations which match these statements.*
- Step 3: *Find solutions which have been or might be applied there.*
- Step 4: *Generate ideas by applying these solutions to the creative task.*

We found different techniques, which provide step-by-step sequences of actions or instructions to support the activation and use of analogous situations [15]. Like most idea generation techniques, they are presented in a general form, and use abstract instructions to implement the principle ‘analogy’. For example, ‘Copy Cat’ [25, page 47] instructs the individual ‘to think of who is doing similar things or

making similar products', 'Stereotype' [25, page 68] suggests 'to use a random occupation and how a person in this position would solve the problem' and 'Bionic Ideas' [25, page 229] instructs the participants 'to describe the major principle that underlies the problem and to think of similar principles in nature'. In our opinion, these instructions still leave open the question whether a selected 'occupation' or 'major principle' will lead to effective analogies for a creative task. Therefore, it depends on the experience of the facilitator which stimuli he or she uses to identify analogies.

We propose that the characteristics of an external stimulus affect the cognitive mechanism of analogical thinking. With the purpose to devise characteristics for an external stimulus, we used SIAM to analyze analogical thinking and the resulting analogous situation. In the next section, we will present our resulting assumptions and hypotheses.

6. Assumptions and hypotheses

Based on SIAM, we define analogical thinking as a multistage process. Confronted with a creative task, an individual activates the image of the creative task. The concepts of the image can be used in an associative process to activate images which have an analogical connection to creative task. An analogical connection is given, if the images overlap to a considerable degree: they share related concepts with each other. Knowledge of the analogous image can be transferred by combining the concepts of the images with one another.

External stimuli can be used to guide the individual during the cognitive processes for the activation of analogous images. To support the ideation process, an analogous situation needs to provide knowledge that can be used to generate ideas for the creative task. This leads us to the question:

What kinds of external stimulus activate efficient analogous images?

According to the initial situation of analogical thinking, the individual analyses the given creative task for major principle and concepts which can be used to think of analogous situations. We think that the creative task can be analysed in two ways.

One way is to analyse the context of the creative task. By identifying the situation that includes the creative task, the individual can think of analogies with a similar context. These analogies may provide knowledge that can be used to solve the creative task. The shared concepts of both images have a strong

association to the context of the creative task; they share the same or a close conceptual domain. This intersection increases the probability that knowledge of the analogous image can easily be transferred to the image of the creative task. The generated ideas results from a similar context which increase the probability that they can be implemented with medium or without effort.

We propose that external stimuli can be characterized by their relationship to the context of the creative task.

The property 'typical' characterize the relationship between an external stimulus and the context of the creative task. An external stimulus is 'typical for the context of the creative task' if it is a strongly associated concept of the image that describes the context of the creative task.

For example, the context of the creative task 'a university wants to provide a new service for students' is a university. Concepts which are strongly associated to the image 'university' are 'a professor works there', 'has a science lab' or 'has a library'. These concepts represent stimuli which are typical for a university, because during a free association process they will early activate the image 'university'. In contrast, concepts like 'has a building' 'is part of a city' or 'people work there' are shared by many other images.

Beside the analysis of the context of the creative task, an individual can focus on the creative task itself. By identifying the major principle that underlies or influence the creative task, the individual can think of analogies with a similar task. These analogies may provide knowledge about existing solutions that can be transferred. The generated ideas results from existing solutions for similar tasks which increase the probability that they fulfil the requirements of a solution for the creative task.

We propose that external stimuli can be characterized by their relationship to the creative task.

The property 'relevant' characterizes the relationship between an external stimulus and the creative task. An external stimulus is 'relevant for the creative task' if it is a strongly associated concept of the image that describes the creative task.

For example, concepts which are relevant for the creative task 'a university wants to provide a new service for students' are concepts which are associated to the image 'students' like 'live in an apartment-sharing community' or 'have a low budget for the month'. These concepts represent stimuli which could be relevant for a possible solution, because they provide problems, processes or

purposes that can be used to generate ideas. In contrast, concepts like ‘a professor has a high salary’ or ‘people work at the university’ or ‘the science lab is on the second floor’ are not necessarily relevant for the creative task.

To investigate the influence of the defined characteristics of stimuli on idea generation techniques using ‘analogy’, we defined the following null hypothesis:

H₀: *There is no significant impact of stimuli characteristics on the outcome of an idea generation technique using the principle ‘analogy’.*

Furthermore, we define the following hypotheses:

H₁: *A statement of the creative task can be characterised by the properties ‘typical for the context of the creative task’ and ‘relevant for the creative task’. Participants who have similar knowledge about a creative task and its context, will categorize a given statement similar with regard to these properties.*

H₂: *People generating ideas in response to external stimuli with the property ‘typical for the context of the creative task’ should generate a higher number of ideas which can be implemented with medium or without effort, compared to people using external stimuli which are ‘not typical for the creative task’*

H₃: *People generating ideas in response to external stimuli with the property ‘relevant for the creative task’ should generate a higher number of ideas which fulfil the requirements of the creative task, compared to people using external stimuli which ‘are not relevant for the creative task’*

In order to test the hypotheses, we designed an experiment that implements an idea generation technique with the underlying principle ‘analogy’ using stimuli with different characteristics.

7. Evaluation of the hypotheses

We designed a multi-stage experiment to test our hypotheses. The creative task was ‘How can a supermarket increase its popularity among its customers?’ This task was used because all participants were familiar with the context of the creative task. In the next section, we will explain the procedure and the results of both experiments in detail.

7.1. Characteristics of a statement

In a first stage of the experiment, we tested our hypothesis that a statement of the creative task can be characterised by the properties ‘to be typical for the

context of the creative task’ and ‘to be relevant for the creative task’ (see H₁).

Input for this experiment was a set of eighty-one different statements which describe the creative task and its context. These statements were generated by the authors in an associative process using statements like ‘supermarket’ and ‘customers of a supermarket’ as stimuli. Examples of the resulting statements are:

- *a supermarket is anonymous*
- *a supermarket is part of a nationwide company*
- *a supermarket distinguishes between regular stock and promotional goods*
- *a supermarket has a parking lot*

The generated statements were categorized by five experts, two women and three men. The experts were deemed to be appropriated subjects for this experiment, because they have experience with the design of ideation workshops and were familiar with the context of the creative task. Each expert received all statements as a randomly organised list and was instructed to score each statement individually with regard to the definition of the properties ‘typical’ and ‘relevant’.

The property ‘typical’ was scored on a scale of 1 (not typical: the statement is weakly related to the context of the creative task) to 4 (very typical: the statement is strongly related to the context of the creative task). We defined a statement as typical for the context of the creative task, if the score was 3 or better.

The property ‘relevant’ was scored on a scale of 1 (not relevant: the statement is weakly related to the creative task) to 4 (very relevant: the statement is strongly related to the creative task). A statement was defined as relevant for the goal of the creative task if the score is 3 or better.

We sum up the scores of the experts to categorise the statements into the categories: ‘typical - relevant’; ‘not typical - relevant’; ‘typical - not relevant’ and ‘not typical - not relevant’. Further we interviewed the experts with regard to their experience with the defined properties during the categorisation of statements.

7.2. Results of the categorisation

The results of the categorisation of statements against the criteria ‘typical’ and ‘relevant’ are shown in Table 1. Eighteen statements were similarly categorised by all experts (22.22% of all statements). The number of statements which were similarly categorised by four or more experts was 54 (66.67% of all statements). Only nine statements were rated

consistently (no more than one score different for a criterion) on both criteria by all experts.

The results of the categorisation suggest some support for the Hypothesis H₁. However, the interviews with the experts showed that personal experiences influence the categorisation process. For example the statement: ‘a supermarket receives a significant proportion of the private household budget’ (scores for typical: 2, 2, 3, 2, 4) was interpreted differently by the authors. According to the personal situation, the experts have several associations to a supermarket in relation to their household budget. Also, the experts indicate that the property ‘relevant’ was highly subjective because of missing criteria for the identification of a relevant statement for the creative task.

Table 1. Results of the categorisation of statements with against their characteristics

equally categorised by all of the five experts			
relevant	Yes	0	2
	No	14	2
	No	Yes	
typical			

equally categorised by four or more experts			
relevant	Yes	7	5
	No	32	10
	No	Yes	
typical			

equally categorised by three or more experts			
relevant	Yes	15	7
	No	39	20
	No	Yes	
typical			

7.3. Influence of the stimulus characteristics

In a second experiment, we tested our hypothesis that the characteristic of an external stimulus affects the cognitive mechanism of analogical thinking (see H₂ and H₃). We designed an experiment that implements an idea generation technique with the underlying principle ‘analogy’ using stimuli with different characteristic to solve the given creative task: ‘How can a supermarket increase its popularity among its customers?’ This experiment has two dependent variables: the number of ideas generated for a stimulus with a defined characteristic, and the characteristic of the generated ideas itself. The characteristic of generated ideas was analysed with regard to ‘practicability: the effort that is needed to

implement the idea’ and the ‘effectiveness: the degree the idea solve the problem’.

We used twenty statements of the most consistently categorized statements of the first experiment as external stimuli for the idea generation technique, five statements for each of the four categories:

‘typical - relevant’ statements:

- a supermarket has several parallel cash registers
- a supermarket has convenience goods
- a supermarket offers a great variety of goods for sale
- a supermarket provides products for many personal situations
- a supermarket provides similar goods with different prices

‘not typical - relevant’ statements:

- a supermarket treats everyone equally
- a supermarket has a parking lot
- you try to make your stay there as short as possible
- at a supermarket you have to stand in a queue
- a supermarket staff puts goods together according to the wishes of the customers

‘typical - not relevant’ statements:

- people make a list of the products they are looking for there
- a supermarket presents goods on long shelves
- a supermarket has shopping carts
- a supermarket uses announcements to get the customers’ attention
- at a supermarket you buy more goods than you wanted

‘not typical - not relevant’ statements:

- a supermarket advertises in the local paper
- a supermarket wants to make a profit
- using a supermarket requires a car
- supermarket staff wears an uniform
- at a supermarket you meet many strangers

Twenty-two students from a large university participated individually in an ideation workshop, five women and seventeen men. The students’ age ranged from 21 to 31 years (M= 23.54; SD=2.87). Students were deemed to be appropriated subjects for this study, because they are familiar with supermarkets and represent potential customers. They were further motivated to participate because 1) they were interested in the topic of creativity or 2) they received course credit for their participation.

Upon arrival, a facilitator informed the participants verbally about the creative task of the experiment. The participants were told to write down different analogous situations for a set of statement

and to use their knowledge about these situations to generate ideas for the creative task. The process sequence used can be described as follows:

Repeat the following steps until all of the provided stimuli have been used:

- Step 1: *The participant receives a statement as a stimulus for the creative task.*
- Step 2: *The participant generates a list of analogous situations which he or she associates with this statement (duration: 1 minute).*
- Step 3: *The participant uses the list of analogous situations to generate solution for the creative task, by thinking how this task has been or might be solved in this analogous situation (duration: 4 minutes).*

The facilitator used an example to demonstrate the process in detail. During the experiment, no verbal communication was allowed between the participants. Further, the participants were requested not to judge any idea in mind and to write down every idea during the experiment.

After the introduction, each participant received a set of twelve different statements as stimuli, three of each of the four categories. The stimuli for each category were randomly selected and organised in a way that each stimulus belonged to a different category than the one that preceded it (A-B-C-D-A-B-C-D...). During the study, each of the twenty statements was used not less than ten times as a stimulus. To assign an analogous situation and the resulting ideas to a provided stimulus, the participants received a set of forms that documents these relations by predefined identification numbers.

One thousand two hundred and twenty-two generated ideas were generated during the ideation workshop. All ideas were digitised including information on 1) the participant who generated the idea 2) the analogous situation used 3) the stimulus which was used to generate the analogous situation, and 4) the position of the used stimulus in the set of stimuli of the participant. Non-ideas, including statements which only described the analogous situation or comments, were excluded.

The ideas were independently scored by three experts, who used two four-point scales to rate each idea with regard their practicability and effectiveness for the creative task.

Scale for ‘practicability’:

- Score of 1: *impractical - the idea cannot be implemented by a supermarket without great effort*
- Score of 2: *less practical - the idea cannot be implemented by a supermarket without effort*

Score of 3: *practical - the idea can be implemented by a supermarket with medium effort*

Score of 4: *very practical - the idea can be implemented by a supermarket without effort*

Scale of ‘effectiveness’:

Score of 1: *ineffective - the idea will not increase the popularity of a supermarket for customers*

Score of 2: *hardly effective - the idea will increase the popularity of a supermarket for a small number of customers*

Score of 3: *effective - the idea will increase the popularity of the supermarket for most customers*

Score of 4: *very effective: the idea will increase the popularity of the supermarket for all customers*

The overall score for each criterion of a generated idea was calculated by summing the scores of each expert and subtracting the number of the experts. Thus, a criterion ranges from 0 to 9.

7.4. Evaluation of the generated ideas

The results of the evaluation of the generated ideas in relation to their own characteristics and the characteristics of the used stimuli are shown in Table 2. The analysis showed that the scores of the experts were in agreement (no more than one score different) in 90.6% for the criterion ‘practicability’ 92.4% for the criterion ‘effectiveness’.

Table 2. Results of the categorisation of the generated ideas against their characteristic

relevant: Yes	effectiveness	Yes	130	42
		No	81	46
		No	Yes	
practicability				
typical: No				

relevant: Yes	effectiveness	Yes	149	49
		No	74	51
		No	Yes	
practicability				
typical: Yes				

relevant: No	effectiveness	Yes	144	31
		No	86	46
		No	Yes	
practicability				
typical: No				

relevant: No	effectiveness	Yes	146	44
		No	64	38
		No	Yes	
practicability				
typical: Yes				

According to the Hypothesis H₂, external stimuli with the characteristic ‘typical’ generate 10.3% more ‘practicable’ and 1.8% less ‘non practicable’ ideas

than the principle ‘analogy’ using external stimuli which are ‘not typical’. For the Hypothesis H₃ we found that external stimuli with the characteristic ‘relevant’ generate 1,4% more ‘effective’ and 7,7% less ‘non effective’ ideas as the principle ‘analogy’ using external stimuli which are ‘not relevant’.

We used a multivariate analysis of variance (MANOVA) to test the influence of the stimuli characteristics on the outcome of the idea generation technique using ‘analogy’. The test showed that the criterion ‘typical’ of an external stimulus did not have a significant effect on the ‘practicability’ of the generated ideas ($F = 3.230$, $df = 1$, $p = .073$, $\eta^2 = .003$). However, we found statistically significant difference between the independent variable ‘relevant’ and the dependent variable ‘effectiveness’ ($F = 4.594$, $df = 1$, $p = .032$, $\eta^2 = .004$). Hence, we reject our null hypothesis.

Table 3. Results of the MANOVA test

Source	Dependent Variable	<i>F</i>	<i>df</i>	<i>p</i>	η^2
typical	practicability	3.230	1	.073	.003
	effectiveness	.257	1	.612	.000
relevant	practicability	.772	1	.380	.001
	effectiveness	4.594	1	.032*	.004
typical x relevant	practicability	.297	1	.586	.000
	effectiveness	0.11	1	.918	.000
<i>F</i> = the ratio of two mean <i>df</i> = the degree of freedom Squares <i>p</i> = the p-value η^2 = ratio of the variation * = is significant at the level 0.05					

8. Limitations

A number of limitations exist in this multi-stage experiment. The study only used one creative task (generation of service ideas). Therefore, the results cannot be generalised to other tasks until the study has been repeated with other kinds of tasks (e.g. the generation of product ideas). The study uses sentences and phrases as stimuli to support the mental process of an individual. It would be necessary to analyse the characteristic of other types of stimuli, like a picture that provide more information as a sentence and allows the individual much more space for interpretation. Limitation is also given by the use of a small number of students in a laboratory experiment. A larger sample size should reduce the affect of possible outliers in the measured data on the result.

9. Conclusion and practical implications

This paper presents the results of an experiment that analysed the influence of the external stimuli characteristics on the outcome of idea generation techniques. We used the ‘change of perspective’ as an approach to classify idea generation techniques. The paper focuses on the change of perspective ‘analogy’ as an underlying principle of idea generation techniques which use knowledge about analogous situation to generate ideas for a creative task. Based on literature research on analogical thinking, we introduced a new approach to characterise external stimuli for ‘analogy’ by the properties ‘typical’ and ‘relevant’. We designed a multi-stage experiment to test our assumptions that the characteristic of an external stimulus affect the generation of ideas. The result suggests significant support that external stimuli with the characteristic ‘relevant’ affect the outcome of ideation process.

The practical implication for practitioners is given in different ways. With regard to the Fuzzy Front End, the practitioner could use the defined stimuli properties to generate and select sentences and phrases as external stimuli for an idea generation workshop.

In a first step, different possible stimuli can be generated systematically by using categories for the analysis of the creative task. One such set of categories is formed by the ‘eight P’s’ (Parts, Properties, Problems, People, Processes, Places, Parameters, and Purposes.) By asking questions such as ‘What parts does a creative task have?’, ‘What properties does a creative task have?’ or ‘What problems are associated with the creative task?’, a large set of possible stimuli can be quickly generated.

In a second step, external stimuli will be selected by using the properties ‘typical’ and ‘relevant’. If the solutions need to be implemented in a short time, the practitioner should prefer stimuli which are typical for the context of the creative task. These stimuli will guide the individual to analogies which share the same or a close conceptual domain with the context of the creative task. Otherwise, if the solutions need to be effective solve the creative task; the practitioner should select stimuli which are relevant for the creative task and reflect some requirements which need to fulfil by a solution. Our experience with innovation workshops has shown that a set of different stimuli with different characteristics should be used. Because of the different cognitive abilities and the personal experience of the participants, an external stimulus does not necessary lead to similar analogies.

However, future research is needed to analyse the influence of external stimuli characteristic on given idea generation techniques with regard to the creative task and the involved participants. We will need further guidelines and methods that support the innovation manager in designing, configuring and selecting an appropriate idea generation technique for an innovation goal. In this manner, we hope to make the ideation processes for the Fuzzy Front End more efficient.

10. References

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