Effect of external activate factors as a hint: creating hypothesis and rules for new story-telling

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Abstract

Why is there demand of consultants and outside directors? That is because what they are asked for objective advice and hint – this paper describes them external activate factor – is precious. This paper focuses on how the external activate factor affects human creativity, especially the process of product planning in business field, and the author conducted an experiment to compare the effect of external activate factor at a lecture of Graduate school. As a result, when the external activate factor is provided, emergence of abduction and new rules was observed, and the effect of storytelling was confirmed. Further research is to find what kind of external activate factor is preferable.

1 Introduction

A decision of human being is often influenced by others [Asch, 1951]. The author conducted an interview to Head of IBM Research Japan, asking 'What is your principle at work as Head of R&D does not research indeed.' Responding to this question, he said "It is important to give some clues to researchers. They tend to have bias on their own topic and are so wrapped up in it, which, however, will not bring anything innovative. So, as Head of the center, I provide researchers with external stimulation. In that sense, my job is heuristic." Since then, the author has been interested in the effect of external inputs to creative activities.

Some research observed a scene when creativity is triggered by ambiguous ideas [Gaver et al, 2003] and examined external restricting condition motivates creativity [Bonnardel, 2000]. An occupation of subjects in these articles was nothing but a designer so that no attention has paid to effects of activate external factor in the process of product planning in business. Given that, the author set Research Question of this article as follows:

> How external activate factor as a hint affects the way of thinking when dealing with ill-defined creative ideas including product planning?

Considering articles on creating novel ideas, the author's interest focuses on power of Analogy [Holyoak and Thagard, 1995]. Analogy brings us valuable words for better understanding, when teacher explains the programming to students [Burstein, 1986]. Although the programming know-how can be the target that the teacher knows, this research explores the activation of thinking in case that the target is unknown. Gick and Holyoak (1980) pointed out that but for obvious external activate factor, the effect of analogical thought gets weakened. This paper focuses on effects that analogical thought brings not in the case hint was given, but in a case that a clue was actually provided.

2 Concept Creation on the basis of an external activate factor

The idea to address the above mentioned research question was referred the effect of combining different elements [Wilkenfeld and Ward, 2000, Costello and Keane, 2000]. The logic behind the development of the tool is as follows. Theoretical premises are based on the creative activity model [Hori, 2007] expressed in the following formula.

$$\dot{q}_{\lambda} = -k_{\lambda}q_{\lambda} + \sum_{\mu} g_{\mu_{\lambda}}\alpha_{\mu} + F_{\lambda} \tag{1}$$

$$\dot{\alpha}_{\mu} = -\gamma\alpha_{\mu} + \sum_{\lambda} h_{\lambda_{\mu}}q_{\lambda} + \Gamma_{\mu} \tag{2}$$

,where $\dot{q}_{\lambda}$ is the differential calculus of creative concept's activation, α_{μ} is the component of concept factor, both $-k_{\lambda}q_{\lambda}$ and $-\gamma\alpha_{\mu}$ are natural diminution and both F_{λ} and Γ_{μ} are external activation.

Based on the above model, this research has designed to enjoy categorization of words (α_{μ}, $\mu = 1,2,\cdots20$) in consideration of not only similarity but also analogy so as to make batch of words to produce new concepts (q_{λ}, $0 < \lambda < 5$). As one word has plural interpretations, the testee shall consider the suitable meaning to the relevant word.

The experimentation is made twice per testee, the 1st time is without an external activate factor which effects on F_λ and Γ_μ, the 2nd time is provided with the external activate factor. Both $g_{\mu\lambda}$ or $g_{\mu\lambda}$ represent various motion captures in this research.

Changes in human behavior between with and without external activate factor have already been observed quantitatively [Nakamura and Ohsawa, 2008]. This paper attempts the qualitative analysis to find if the external activate factor makes a difference in product planning, utilizing the words given in the classes at a graduate school.

3   Analytical Method

Note that both input and output from/to the developed tool use only unstructured data, i.e., a noun written on cards displayed on the screen.

At the end of the experiment, the system provides two types of output: one is a cluster of cards that signify product ideas. For this purpose, participants move and collect words by dragging them from given 20 words. These words are combined according to participant interpretation of new ideas of products or services. In order to identify the clusters, participants make them clustered considering the structure of entire story-telling.

Upon completion of the experiment but prior to analysis, the outcome contents are transformed into a first-order predicate logic expression. A semantic analysis is performed as follows. The number of individual constants and the length of the formal logic regarding the output are considered the *depth of attributes*. Then, those indicators are examined relative to how deeply participants considered the created products. To calculate the depth of attributes of individual constants, an expression of created products is formalized as follows, where P is either an individual constant or a variable, and t is a term to be quoted.

$$P(t_1, t_2, t_3, \cdots, t_n) \qquad (3)$$

Here, term (n) is interpreted as the depth of attributes, whereas the length of the formal logic regarding the reason why the product created, which is interpreted as background or a differentiator, is counted with both the number of logical connections and the predicate symbols that are assumed as an appropriate level of satisfaction, assuming no contradiction has occurred. For example, following the former expressions, and/or representations [Tsujii, 1987] can be better satisfied than the latter one by considering the number of terms, predicate symbols, and logical connections.

$$\forall x \exists y (Human(x) \rightarrow Eq(father(x), y) \wedge Human(y))$$
$$\forall x (father(x) \rightarrow Human(x))$$

A formal analysis is then performed as follows. The output is analyzed in terms of *richness of knowledge and/or memory*. The level of richness of knowledge and/or memory

is defined as shown in (Eq. (4)), where k is the sum of the number of nouns, verbs, adjectives, which is determined by morphological analysis, and the number of arrows and boxes for better expression in the presentation material regarding created product. m is the number of nouns and verbs ($k > m > 0$) that are the same as those shown on the cards remaining in the workspace, which are considered as the final composition of the combined cards. By using adjective and adverb within the context, it makes the contents enrich of being substantial, and bring it to better understanding, although it is not a sort of a rhetoric manner. This means that as the percentage increases, more external knowledge and/or memory is introduced in the context of richness of expression. This is considered based on the assumption that a frequent use of adjective and/or adverbs, which is not a rhetorical manner, enrich the outcome in the context of story-telling, and the content of being substantial, and bring it to better understanding.

$$Knowledge._\mu = \sum (k - m) / \sum k \qquad (4)$$

Based on methodology described above, the author conducted experiment in classes at a graduate school with fashioned four brands such as facebook, starbacks, tripadvisor, and Ikea to attract and motivate participants as shown in Figure 1. 13 students were divided into three groups and asked them to think about new products, being given keywords below at the beginning. Capital letter describes concepts representing Cluster.

- TRIP ADVISOR: discount ticket, foreign tour, backpacker, guide, and word of mouth
- FACEBOOK: search, friends, like!, share, and network
- IKEA LIFE: living room, do it yourself, easy to store, Europe, and wardrobe
- STABA LIFE: yen400, third place, extra job, coffee, and steamer.
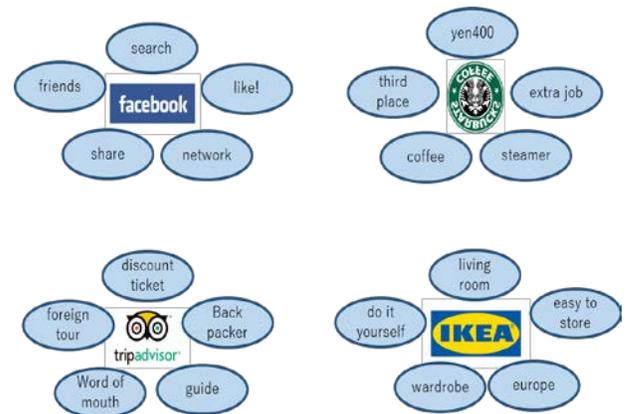
Figure 1: The idea of words are given for the experiment

The first round had no external activate factor as a hint, and in the second round, "SAMSUNG" was given as an external activate factor. Capital letter describes concepts representing Cluster.

4 Results

Table 1 shows the results of calculation by the method above. Every Group indicated higher score of Eq.(4) in the second round than the first one.

Let's discuss Group 1 scenario in which richness of knowledge and/or memory was the highest. Firstly, the author compares hypothesis reasoning of each output, with and without external activate factor.

Table 1: Result of calculating according to Eq(4)

Group	Round	k	k-m	Eq(4)
Group 1	1st	47	22	47%
	2nd	54	29	54%
Group 2	1st	50	25	50%
	2nd	53	28	53%
Group 3	1st	55	30	55%
	2nd	59	34	58%

Clusters made without any hint were as follows and came with supplemental explanation.

- SIM Card: discount ticket, network, do it yourself, and yen400
- SHARE HOUSE: backpacker, share, living room, and third place
- CAMPING: foreign tour, friends, Europe, and coffee
- SNS: word of mouth, guide, like!, and extra job
- IoT: search, easy to store, wardrobe, and steamer

Out of clusters above, supplemental explanations came along with the first cluster was saying "Selling Sim Card to tourist that arrive into Japan." Other clusters also had explanations of the same volume. When it comes to SIM Card, it could be formally described in the following manner.

P_1: Selling sim card to tourist that arrive into Japan
Set={r1: sim card→to be bought in Japan}
Fact={sim card→discount ticket, network, do it yourself, yen400, Using sim card in Japan→being able to communicate}
Hypothesis: Tourist in Japan needs for Sim Card to communicate
Consequently, F U {Σr, h} expects revenue of sim card, which means that we take hypothesis h, where selling sim card to tourist is satisfied with rule r1, the given fact, and hypothesis h.

As noted, hypothetical reasoning which explains relations of SIM Card as one of the clusters, and a word 'tourist.' Nevertheless, four keywords composing a SIM Card cluster, discount ticket, network, do it yourself, and yen400, are all just factors explaining sim card itself. In other words, additional 'logical rule' was not detected and the depth of attribute was still at low level.

Other Cluster, SHARE HOUSE, CAMPING, SMS, and IoT, also indicated the similar tendency in logic as SIM CARD, which means that cards composing Cluster are less likely to be interpreted as additional 'logical rule.' In addition, story-telling connecting Clusters is simple as below.

{enjoy(camping) ^ stay (shared house)}→ {needs for (SNS, sim card, IoT)}　　　　　　　　(5)

Like this, all the keywords were replaced with variable symbols. Moreover, a logical rule was evoked by connecting each Cluster.

Then, the same subjects did another round. Subjects were provided with a keyword SAMSUNG as external activate factor in the second round, results of which is demonstrated in Figure 2.
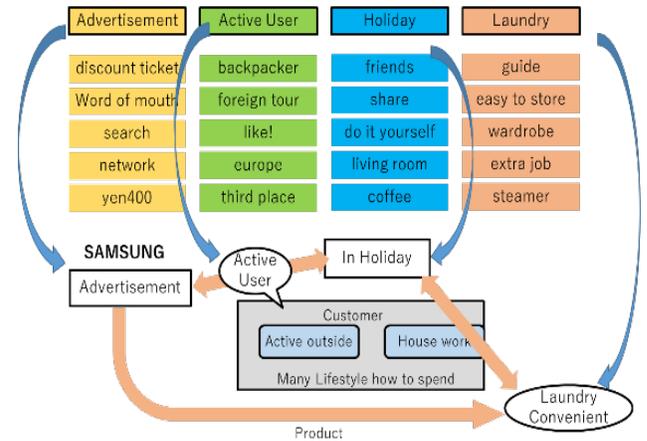
Figure 2: The slide of the 2nd round experiment presented by Group 1

The same outcome as the first round was each Cluster consisted of relevant cards. Nonetheless, each story-telling related to each Cluster has much more additional expressions than the first round. It is possible to interpret new story as 'SAMSUNG washing machine make customers' lifestyle active. On days off, lifestyle can be both outdoors and house chores.', while using SAMSUNG washing machine, that makes users feel active. This interpretation can be formalized in the formal logic with predicate symbols.

$\forall$ x(((human(x) $\land$ buy(laundry))→(feel(active, holiday) $\land$ human(x)$\land$(spend(place(outdoor$\lor$house), lifestyle)))　　　　　　　　(6)

While (5) is consisting of created clusters where the given cards are combined with, (6) is consisting of created words as variables, e.g., active, lifestyle, house, and so on., that are not shown on the screen supporting created clusters where the given cards are combined with. Therefore, comparison of (5) and (6) makes it clear that external activate factor enhances the depths of attribute. In other words, context becomes more complex.

Most of all students gave author their feedback on the experiment called as an analogy game in the class, representing below:

> It was my first time to join such an exteriment that was beyond my imagination. It helps so much to generate business idea without framework. During the exteriment I experienced that my brain becomes active than normal. This is so interesting.

5 Conclusion

This paper executed the certain pattern in the effect of external activate factor in the process of product planning. At the same time, the number of subjects were limited so that it needs to conduct observation repeatedly in further experiments. Also, a proposition such as what type of external activate factor should be given, was not fully answered.

As stated in earlier parts, if defining activities giving an external activate factor as heuristic, it would be challenging to identify the factor. Given that social issues including environment and social welfare widely gives psychological impact on people [Mead, 1934], questioning social issues could be one choice of external activate factor. In other words, social issues have deep insight and are dependent on interaction with society [Csikszentmihalyi and Sawyer, 1995], providing social problems like environment issue might be one of the interpretations of external activate factor. At any rate, in order to enhance the reproducibility of the factor effects, the author is willing to extract characteristics of the facgtor itself.

Acknowledgments

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