

Research Article

Cognitive Biases as a Clue to Creating Diversified Stories

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ARTICLE INFO*Article History*

Received 23 November 2020

Accepted 30 August 2021

*Keywords*Story
cognitive bias
analogy
creativity**ABSTRACT**

A wide variety of stories can be created from the same material. The author asked several teams to create stories, focusing on cognitive biases. As expected, a variety of stories were created by each team, and cognitive biases were identified in the process of creating them. In other words, if it is assumed that cognitive bias is a driving force behind the creator's intentions, then it can be concluded that the creator must have a certain strong intention when creating a story.

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1. INTRODUCTION

The word “creativity” can be used to describe a wide range of products, depending on what one is creating. The product may be an object, a service, or a new technology. Whatever the case, to attract people, it is important to tell a “narrative story”, and I believe that an attractive story makes a deep impression on people and inspires them to remember it.

I have been studying the process of designing and generating stories. In doing so, I have focused on how the characteristics of stories change depending on the presence or absence of external stimuli [1]. This paper is focused, first, on the effects of availability heuristics, termed cognitive biases in this paper, such as the selective use of memory. I explore the process by which different teams given the same data set create different stories.

Section 2 touches on related research and experimental tools. Next, Section 3 describes stories' impression points, items for assessing cognitive biases, and method to assess diversity of created stories. This is followed by Section 4, which introduces an experiment based on participants' self-assessment. The results of the experiment are then presented in Section 5. This is followed by a discussion aimed at analyzing and interpreting the results of the experiment, and the final Section offers a conclusion.

2. RELATED RESEARCH AND EXPERIMENTAL TOOL

As an area of research in support of activities to create stories, the aim was to develop games that enhance composition and creativity

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to reconstruct combinations of words and thereby create new concepts. The importance of the meaning and role of words in the design process, which is a creative activity, has been noted [2]. The game developed is aimed at connecting words by analogy [3] and discovering new expressions in various combinations. It is called the Analogy Game [4].

This type of game falls into the category of “serious games” in the broadest sense of the word. Serious games are defined as “games used to solve problems in education and other areas of society” [5]. Examples would include training in firefighting activities, emergency and medical training, and language learning. Overseas, the use of serious games to address the issue of the educational use of games has been attracting attention [6]. Since this analogy game was aimed at fostering composition and creativity, it is of a type that players explore and structure by themselves [7].

The gaming interface was developed as in Figure 1 as an experimental tool. Here, the “player” initially finds 20 words (items), each shown in a small-square node (Figure 1A). These words are set considering any objective relevance. Then, the player categorizes the words so as to make clusters, by dragging the node freely on the screen, according to his/her subjective awareness of the analogy (Figure 1B).

When the player notices the emergence of a concept based on his own arrangement or due to dynamical shift of his cognition, he/she can subscribe the concept by filling in the balloon as in Figure 1C. And, if the player finds a common concept corresponding to a cluster on the display, he/she can color the node in the cluster following his awareness.

Via this procedure, we expect the player to create new stories underlying his/her own arrangements.

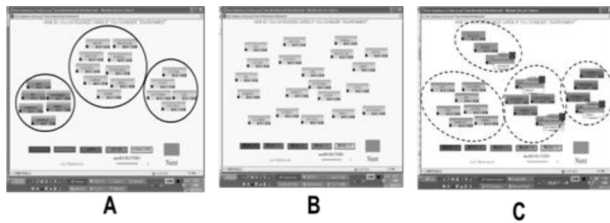


Figure 1 | Flow of the analogy game.

3. STORY IMPRESSION POINTS AND ASSESSMENT

The aim of the experimental tool mentioned in the previous Section was to support creative activities [8]. The present Section explains impression points in story creation as a deliverable self-assessment through debriefing after the game.

3.1. Story Impression Points

It has been suggested that creativity can be evaluated from the viewpoints of originality and novelty as well as practicality and appropriateness [9]. Therefore, the author concluded that “Innovative” and “Feasible” are appropriate as impression points for created stories. Of these two items, I used the term “innovative” as a single term so that the difference between originality and novelty could be judged intuitively without having to be broken down into details. Feasible is also used in the same way, and “practically and appropriateness” are combined into feasible.

In addition, three impression points, Usefulness, Scale expansion, and Barrier to rival, were added, with reference to the value proposition design proposed by Imazu [10],¹ which excluded quantitative evaluation points. For example, in the case of a multifunctional printer, score of “usefulness” would be high if the product is developed in-house and particularly integrated with after-sales service in consideration of user’s counterpart. Sales expansion could score low because if consumables and after-sales service are used as ongoing income, labor costs will be a drag in securing maintenance personnel. Barrier to rival becomes a high score because it is difficult to imitate if the product is inexpensive and has good performance.

Therefore, the following five items were identified as the impression points for created stories in this paper: Innovation, Feasibility, Usefulness, Scale expansion, and Barrier to rival.

3.2. Assessment on Cognitive Biases

Next, the assessment items for cognitive biases are introduced. In relation to cognitive biases, self-awareness is metacognition [11]. In another words, cognition that monitors, controls, and evaluates itself is called metacognition. Wells [12] developed metacognitive therapy, which attempts to utilize metacognition as a type of therapy rather than a training method. It is characterized by theories and therapeutic techniques based on cognitive information processing.

¹She is an evangelist in Japan for the Business Model Generation.

This paper aimed to use metacognition to explore the source of story creation. For this purpose, as described in the first Section, the participants were asked to self-assess relevant characteristics, considering the availability heuristics such as people’s selective use of memory, as forms of cognitive bias. In this case, what are the types of cognitive bias? Bazerman and Moore [13] identified 11 types of bias that can occur during decision making. In this paper, four of these were selected for consideration in creative activities, excluding quantitative items.

- Ease of Recall: cognitive bias that occurs toward easily recalled material based on the clarity of memory.
- Retrievability: cognitive bias toward an object to be remembered that is structurally easy to retrieve.
- Confirmation trap: cognitive bias based on the assumption that one’s own hypothesis is correct.
- Anchoring effect: cognitive bias toward available information as a starting point and tendency not to move far beyond that anchor.

Based on the above, the assessment items for cognitive bias were organized in this experiment as follows.

Assessment item 1 (memory versus hypothesis)

1-X = Recalling someone’s *memories of past events* affected your ideas.

1-Y = Not your memories but your team’s *own tentative hypothesis* affected your ideas.

Assessment item 2 (stuck to the cards versus took off from cards)

2-X = You were affected by the meaning of a given set of cards and continued to *stick with* that until the end.

2-Y = You were influenced by a given set of cards, but the idea *took off from* that.

Assessment item 3 (not shared versus shared)

3-X = During the team discussion, a unique idea arose that was *not shared* by other individuals.

3-Y = The ideas were sufficient using only the information *shared* among team members.

Assessment item 1-X was combined with Ease of recall and Retrievability because both were types of cognitive bias related to ones’ memory of the past. On the other hand, assessment item 1-Y asked the participants whether they felt a cognitive bias suggesting that they believe their hypothesis is correct as a confirmation trap or as a memory of the past.

Assessment item 2-X asked whether the participants recognized the anchoring effect, which is a type of cognitive bias, and assessment item 2-Y asked whether they recognized the expansion of their ideas without their being anchored to a given card.

Assessment item 3 was not a straightforward question of cognitive bias, but it asked for “bounded awareness” in conducting teamwork. In the post-experimental review, assessment item 3-X asked participants whether they felt that the information that they considered useful (i.e., the cognitive bias of the confirmation trap was also present here) was ignored or overlooked. In contrast to

3-X, assessment item 3-Y asked whether the respondents felt that the information that they found useful was sufficiently shared and agreed upon within the team.

3.3. Assessment on Diversity

Prior to analyzing the cognitive biases on created stories, we will see how the Analogy Game introduced in the previous section is used to create various stories. For this assess, the Levenshtein distance will be measured to see how different two strings are, and it measures how many times at least one of the strings needs to be changed (inserted, deleted, or replaced) by a single character to make the two strings match. The minimum cost of insertion, deletion, and replacement is calculated as shown below, and a macro is assembled and calculated where 1 is a perfect match and 0 is a perfect mismatch.

```

For row = 1 To Length1
  For col = 1 To Length2
    If (Strings.Mid(Line1, row, 1)) = (Strings.Mid(Line2, col, 1))
      Then
        cost = 0
      Else
        cost = 1
    End If
    Grid(row, col) = Application.Min (Application.
      Min (Grid(row - 1, col) + 1, Grid(row, col - 1) + 1),
      Grid(row - 1, col - 1) + cost)
  cost = Length1
  If Length2 > Length1 Then cost = Length2
  LebenshteinDistance = (100 - (Grid(Length1, Length2) *
    100)/cost)/100

```

4. EXPERIMENT

In this paper, we conducted an experiment using the analogy game introduced in Section 2 in the following manner:

Experiment date: Friday, November 27, 2020

Participants: 21 second-year students of the Faculty of Global Management, Chuo University

Experimental method: 21 people were divided into six teams and presented with a set of word cards on the screen as follows. Capital letters in the following indicate the names of the clusters, and lower-case letters indicate individual words on the cards.

- TRIP ADVISOR: discount ticket, foreign tour, backpacker, guide, word of mouth
- FACEBOOK: search, friends, like!, share, network
- IKEA LIFE: living room, do it yourself, easy to store, Europe, wardrobe
- STARBACKS: yen400, third place, extra job, coffee, steamer

The above set of word cards is the same as that used in our previous experiment [1]. The difference between the previous experiment

and the present one is that this was an experiment not with one team but with six teams. Participants were instructed to devise a story connecting several newly reconstructed clusters (a set of word cards) using the experimental tool. The story was to be expressed in PowerPoint using a copy of the screen created with the experimental tool. The story was then presented to the participants. After the presentation of the story, participants were asked to do the following two tasks:

- Give a score to stories created by teams other than your own, taking into account the impression points mentioned in Section 3.
- Assess what cognitive biases were present in response to your own team using the assessment items described in Section 3.

5. RESULTS

Even though the word cards provided in the experiment were the same for all teams, different teams created different stories (Table 1). The results for the Levenshtein distance are as follows. In spite of the fact that the initial values are the same, it is confirmed that the distance between each story is divergent. However, it is not a semantic distance, but a formal one. In order to measure the semantic distance, the role of the participants becomes important.

The impression point scores for the six teams are shown in Figure 2, with team 4 receiving the highest rating.

The team 4 story that received the best ratings was the following:

Story theme. *Four things that the students on Working Holiday need might be Cheap clothes, Information, Relax and Tour.*

Story. Since they are working in foreign countries to earn money, study a language, and learn the culture at the same time, it is better to save clothing money and travel around if they have time. To save money on their clothing, it would be better for them to purchase or borrow seasonal clothes at a sales market or garage sale. Also, since it will be difficult to get information in foreign countries, where they do not have friends or family, they might need to use an online

Table 1 | Levenshtein distance between teams

	Team-1	Team-2	Team-3	Team-4	Team-5	Team-6
Team-1						
Team-2	0.06					
Team-3	0.10	0.10				
Team-4	0.05	0.07	0.10			
Team-5	0.13	0.09	0.10	0.10		
Team-6	0.10	0.10	0.09	0.08	0.09	

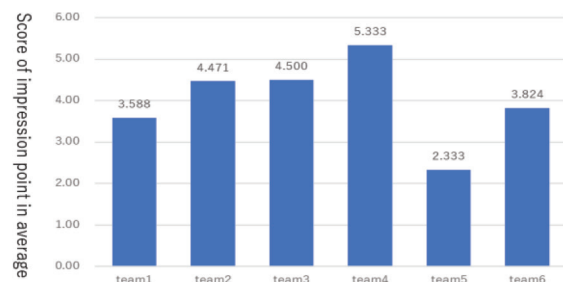


Figure 2 | Impression points rating by team.

community to get various kinds of information during their working holidays. Finally, it is important to relax after work every day.

An interesting slide from the team 4 presentation is shown in Figure 3.

This was written by one of the team members during trial and error as a draft, and when she introduced it to the rest of the team, they marveled, saying with “Hi, hi, hi! Referring to a recording of the members conversation, it was able to extract the flow of the discussion as follows.

- (1) The first four words that stood out to me were, “Do it yourself”, “coffee”, “extra-job”, and “Europe”. I decided to connect the four.
- (2) Think of it this way, it’s a working holiday! That is said, a part-time job in a foreign country is indeed a working holiday!
- (3) On a working holiday, you have to do it all by yourself.
- (4) As a mini-story derived from the above, on a working holiday we need to save money, we might want to go on a tour in our free time, we might need to relax, and we might need information.

The results of the self-assessment from all of participants are shown in Table 2.

6. DISCUSSION

In this Section, we discuss cognitive biases and the structural forms of story representation that we uncovered in the course of our analysis.

6.1. Cognitive Biases

Focusing on teams 4 and 3, which had the highest ratings, what kind of cognitive biases did the team members feel? In team 4, the

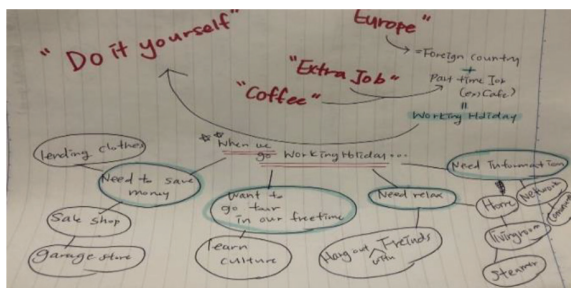


Figure 3 A slide representing the thinking process.

Table 2 Self-assessment of cognitive biases

	Team-1	Team-2	Team-3	Team-4	Team-5	Team-6	AVE	STD-EVP
1-X	3.00	4.25	7.00	3.00	2.67	0.50	3.40	1.96
1-Y	7.00	5.75	3.00	7.00	7.33	9.50	6.60	1.96
2-X	3.00	4.25	5.33	2.67	5.00	5.50	4.29	1.11
2-Y	7.00	5.75	4.67	7.33	5.00	4.50	5.71	1.11
3-X	0.75	4.00	2.67	2.00	4.67	0.25	2.39	1.60
3-Y	9.25	6.00	7.33	8.00	5.33	9.75	7.61	1.60

most remarkable assessment item that the team member reported was item 2-Y, which was unique compared to the other teams. This indicates that they did not stick to the given key words until the end, and they perceived themselves to have made a leap in the meaning of the words. This may be due to the so-called *polysemy* effect, in which a given key word has multiple meanings [14]. It could be said that blending a meaning that is different from the original meaning [15] produced a creative story. In fact, as introduced the thinking process of team 4, the first four keywords (Do it yourself, coffee, extra-job, and Europe) were noteworthy, and through brainstorming using this mini-story as an opportunity, the other keywords were connected to form the whole story.

The second most highly rated team was team 3, which, like team 4, showed characteristic cognitive biases that were different from the other teams. Team 3 had a higher rating on item 1-X than the other teams, i.e., they felt that their memories were more effective in generating stories than were their own free ideas and hypotheses. The possible reasons for this are discussed below.

In the case of team 3, it might be presumed that memory was given priority because the consensus was that teamwork must take precedence over mutually agreed-upon ideas, resulting in the hypotheses of various participants cancelling each other out. However, team 4, the most highly rated team, gave the opposite answer. That is, team 4 responded with a free hypothesis that was not anchored in their own memory. This contrast is quite interesting. Given that teams 4 and 3 did not respond uniquely to the question, it is difficult to figure out the story-generating algorithm. However, at least from the above results, we can say that the cognitive biases of assessment items 1 and 2, whether X or Y, are characteristically different to those of the other teams (i.e., representing highest or lowest awareness).

Now, we discuss assessment item 3. For both team 3 and 4, assessment item Y was ranked higher than item X. This implies that both teams seemed to be in a good environment for the members to share their opinions with each other. The trends in the scores of teams 3 and 4 on team cooperation in Assessment item 3 are similar, but when we refer to the feedback from the participants after the experiment, subtle differences are highlighted, which are correlated with the scores. Although the number of members of each team is equal to three, both positive and negative opinions are mixed in the feedback comments. Here, I dare to give an example representing negative comments as follows:

Team 3:

Through actual group work, we were able to experience the process of who to target as customers, what kind of products to create, and how to promote them. Even though we were able to study how it was done, when it comes to trying it, the target customers were not sufficiently narrowed down, or we could not come up with the idea in the first place.

Team 4:

The AG game was the most impressive task activity for me. Through this activity, I learned that people have different experiences that will affect our thinking process. Despite the fact that people have different experiences and thinking processes, there are certain points that people can generally emphasize and understand.

I thought it was important to narrow it down to a point where people can usually emphasize concepts or stories, especially

when it comes to marketing. When I thought of marketing as the meaning of promotional activities, I generally thought that being emphasized by people was one of the important conditions that marketing should have. In that respect, I learned that thinking about a new plot or promotion in any keyword or product requires feasibility, usefulness, creativity, and innovation.

The following can be inferred from the above. That means, although they both admitted that there were challenges in teamwork, team 4 learned by acknowledging and overcoming these challenges. In particular, I would like to focus on this sentence, i.e., “Despite the fact that people have different experiences and thinking processes, there are certain points that people can generally emphasize and understand.”

The recording also showed that in team 3, the leader of the team gave consideration to the remaining two members (the leader of team 5, which had the lowest score, was more of an opinion leader and gave limited consideration to the remaining members), while in Team 4, one member was quiet and reserved in her comments but two members had lively conversations as if they were friends rather than leaders. This suggests that team 4 scored relatively higher than team 3 in assessment item 3 because they understood that teamwork is about acknowledging and understanding each other’s arguments.

Thus, since the analogy game is a sort of mechanism that encourages creativity, it can be inferred that organizational governance, such as a leader, does not encourage creativity, but rather a freer and more equal relationship is desired, to some extent.

On the other hand, for team 5, which had the lowest score, X was higher than Y, indicating that individual opinions were not reflected. Indeed, from my observations, I had the impression that one leader created the whole story and the details, while the other members were, in a sense, listeners. That means that no chemical reaction yielding new ideas occurred in the mix of different opinions from the team members.

In relation to cognitive bias, the team operation that is well conducted such as team 3 and 4, have removed their members’ cognitive bias by accepting each other’s emphasis and trying to understand each other. Therefore, it is assumed that their environment is conducive to chemical reactions between ideas, and interesting story ideas are generated.

6.2. Structural Forms of Story Presentation

There is one interesting feature in the artifacts of the stories that showed a difference in the evaluation of this experiment. It is the presentation of the structure of the story. At first glance, there is not much difference between team 4 and 5 in terms of the text, and in fact, team 5, the worst team, seems to have a longer and better thought-out story. However, looking at the presentation slides, it became clear whether the story had a title or not, whether it had structural features or not, and so on.

As a matter of fact, team 3, the second team in the evaluation ranking, also used structural expressions in their explanations to make it easier for the audience to understand. Indeed, in Analogy Game, since there are multiple bundles of words, each bundle has a meaning, and it is natural to construct a story by connecting the

bundles. On the other hand, in team 5, there is no structure-like expression anywhere, and the story seems to have been connected by simply scattering the given cards (words) in the text.

This suggests that it is important for a story to have a title and a structure, and that the presentation of the structure facilitates comprehensibility.

7. CONCLUSION

Through the experiments using the analogy game, various stories were created and could be observed. Stories have infinite possibilities, depending on the combination of the given words, the ideas of the members, and the ideas and inspiration of their chemical reactions. In particular, I found that even with the same given data, it is not just a matter of saying that it varies from person to person, but that the complex trial and error caused by the cognitive biases therein can produce stories that were initially unimaginable.

With regard to cognitive biases, those were evident throughout the experiment in the process of creating stories. In other words, if we assume that cognitive biases are the driving force behind the creator’s intentions, then it is essential that the creator have a certain strong intention to yield a memorable story.

The experiment in this paper, however, is just a case study of a limited number of people, and there are still many works to be addressed before the findings can be generalized. In the future, the author intends to focus more on the process of creating stories.

CONFLICTS OF INTEREST

The author declares no conflicts of interest.

ACKNOWLEDGMENTS

This study was carried out with the cooperation of undergraduate students of Chuo University, Japan. Also, the Analogy Game was upgraded and developed further with the support of Mr. Tano, President of Expert Gig Co., Ltd. This research was supported by Kakenhi (JSPS KAKENHI Grants Numbers 17K03872 and 19K03062).

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AUTHOR INTRODUCTION

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He is a Professor of Faculty of Global Management at Chuo University in Japan. He is graduated from the Department of Technology Management for Innovation, Graduate School of Engineering, University of Tokyo, with highest honors. His area of research is cognitive sciences.