A Explorative Study about the Strategies of Serendipitous Discovery

Fumio Kobayashi (b051209d@mbox.nagoya-u.ac.jp)
Graduate School of Education and Human Development, Nagoya University
Furo-cho, Chikusa-ku, Nagoya, Japan

Takeshi Okada (okadatak@p.u-tokyo.ac.jp)
Graduate School of Education, The University of Tokyo
7-3-1, Hongo, Bunkyo-ku, Tokyo, Japan

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What is Serendipity?

Serendipity is a discovery in which valuable or agreeable things not sought for are found (Roberts, 1989). If we look back on the history of science, we can see numerous great discoveries caused by serendipity, such as the discovery of X rays by Roentgen, Pulsars by Bell and Hewish, Penicillin by Fleming, and so on. Serendipity has also played a part in recent discoveries such as Polyacetylene (which led to the Nobel Prize) by Shirakawa. Although a great number of studies have focused on scientific discovery in cognitive science, cognitive psychology, and related fields, there has been no research directly investigating serendipity. Therefore, in this study we focused on serendipity and explored its discovery process.

Experiment

Selection of an episode: We referred to episodes of serendipity in the history of science and chose the "anaphylaxis" episode for a micro-world task. The reasons why we chose this episode are as follows: 1) Anaphylaxis was a great discovery which won the Nobel Prize. 2) In that episode, the researcher employed the same experimental method before and after changing experimental targets. This allowed us to develop the micro-world easily. 3) Participants could easily learn the relevant knowledge necessary for the task. A brief account about the discovery of anaphylaxis: Richet studied poison and expected to observe immunity or resistance against the poison. However, he encountered anaphylaxis instead of immunity. Anaphylaxis leads to a serious allergic reaction, at worst to sudden death. Participants: 12 graduate students majoring in science, and currently involved with conducting experimentation took part in this session. Task: This task was a micro-world task which enabled participants to conduct experiments on the computer. In the task, participants could give a dose of poison "A" (0-100mg) to rats and examine and revise their hypotheses. The task was programmed in HSP programming language. In this task, "anaphylaxis" was programmed to occur instead of immunity. By the second dose, administered at least 3-days after the initial dose, anaphylaxis was observed. Besides anaphylaxis, the lethal amount of the poison was also set in the program. Procedure: The experiment consisted of four phases: Learning phase (learning immunity theory), practice phase, experimental phase (one hour), post-test and interview phase. In the experimental phase, participants were instructed to try to find as many new facts (discoveries) as possible about the poison and to write their hypotheses before each trial (experiment). During the post test, participants were asked how much they understood anaphylaxis. We interviewed them regarding the process they used, referring to logs and tracing their procedures. The entire procedure took around three hours.

Results and Discussion

Chance for Discovery: all participants encountered anaphylaxis in their task, therefore, all participants were given cues or chances for its discovery. Grouping: Judging from the performances at the post test, participants were divided into three groups: High-discovery (HD), Low-discovery (LD), and Non-discovery (ND). Strategies among groups: According to Lacatos (1978), a scientific theory consists of a core theory and peripheral theories (research programme). Peripheral theories protect the core from data which disconfirms the core theory. Hence, in science, it is difficult for a paradigm, composed of a core theory with peripheral theories, to be discarded. By focusing on the experiments that the participants performed for confirming immunity, we detected the use of a particular strategy only in HD. The strategy employed by HD consisted of eliminating the possible influence of peripheral theories after failing to confirm the initial core theory, immunity. Peripheral theories are composed of general knowledge, in this case about poison, and work to prevent a core theory (immunity) from being disconfirmed. To achieve serendipity, disproving the core theory is essential because it is an important step to realizing new phenomenon and shifting targets even while protective theories still exist. We discovered a strategy, employed by participants who were able to achieve serendipity, that eliminates the effects of peripheral theories while attempting to confirm the core theory.

References

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