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CONCERNS: Review of the thesis of Artur V. Ammalainen

Brussels, December 1st, 2022

THE REVIEW

of a member of the dissertation council on the dissertation of Artur V. Ammalainen on the topic: "The effect of processing fluency on the Aha! Experience ratings in insight solution" submitted for the degree of Candidate of Psychological Science in the specialty field 5.3.1. — General Psychology, Personality Psychology, History of Psychology

Overview of the work

The thesis submitted by Artur V. Allamainen (in its English translation) is a document of 137 pages (including glossary and annexes) structured in two chapters flanked by an Introduction, by a "Findings" section, and by a short Conclusion. The thesis is focused on the exciting question of insight – the phenomenon whereby one obtains the solution to a problem seemingly without effort, all at once. This is associated with an Aha! or an Eureka! Experience. Interestingly, insight, which has been extensively studied already, is now again the object of substantial attention in different laboratories (one of my own Ph.D. students will defend his own thesis on insight on December 20th, 2022!).

The work describes four experimental studies that form the core of the dissertation. In the introduction, M. Allamainen rightly points out that what is new about insight research is the focus on the phenomenology associated with it. This, then, is what the thesis is about: What are the affective and cognitive factors involved in problem solving that influence the likelihood of occurrence and the intensity of the Aha! experience? And M. Allamainen hypothesizes that processing fluency is the key factor. The introduction continues by offering a short synopsis of the thesis and of the main hypotheses and research methods. Two central hypotheses are described. The first is that "unreportable hints" (vs. reportable hints) favor the occurrence of Aha! experiences because subjects, who remain unaware of them, attribute the increase in processing fluency to the problem solving process itself rather than to an external source. The second hypothesis is that irrelevant sources of increased processing fluency likewise increase the likelihood of insight experiences. These hypotheses lead to four statements to be defended, which are spelled out in the introduction text.

Chapter 1 provides a thorough and very interesting overview of the literature dedicated to insight. It attempts to provide a definition of insights, offers good discussion of its different aspects, speculates about its function, and briefly overviews extant cognitive theories of insight, in particular the idea of representational change (restructuring) and of the role of unconscious processing. The exposé then moves towards asking what the sources of the experience of insight may be and progressively develops the argument that processing fluency is key, an argument that constitutes the core motivation for the experimental work reported in Chapter 2.

Chapter 2 describes four experiments involving a total of 342 participants. The first two experiments test the hypothesis that processing fluency, when it can be attributed to the problem solving process, is the main driver of the Aha! experience. Experiments 3 and 4 concern the influence of irrelevant perceptual features of words that form part of a problem on judgments about the extent to which the problem affords a solution. Importantly, these experiments used the remote association task (RAT), of which no Russian existed. The author therefore specifically designed Russian language RAT material and carried out a further experiment aimed at testing it.

In Experiment 1, 94 participants were asked to solve anagrams, some of which only afforded one solution, while others also contained a different shorter word. On each trial, people were exposed to the anagram for 10 seconds, and were then either shown a visible or invisible hint, after which the anagram was shown again for 15 seconds. People could respond at any time by pressing the space bar, after which they could enter the solution and rate the intensity of their Aha! experience on a 10-points scale. People were instructed to respond as fast as possible. The hints consisted of pictures representing the solution — i.e., the photograph of a cook for the word "cook"; the photograph of a boat for the word "boat", and so on. Hints could either be true (pointing to the correct solution) or false (pointing to the shorter word), visible (~reportable) or not (~unreportable). This generates a 5(hint type; the 4 above + no hint) x 2(anagram type) design. The results are analyzed through mixed-effects logistic regression models. True hints increase accuracy and decrease reaction times. False hints, contrary to hypothesis, do not increase reaction time. Critically, there is no difference between visible (reportable) and invisible (unreportable) hints insofar as reported intensity of insight is concerned, which runs directly against the study's main hypothesis, according to which the phenomenology of insight should be directly affected by changes in perceived processing fluency when those changes cannot be attributed to an external source, as should have been the case for invisible hints. This lack of difference is interpreted as resulting from the fact that all participants are exposed to visible hints and that they perceived the hints as being useful. The results also fail to replicate Bowden's result, a short informative discussion delineates the differences.

These considerations led the candidate to carry out Experiment 2, in which only unreportable hints are used, and in which multiple scales are now used to make it possible for participants to rate their experience of insight: One scale asked about insight intensity, another about confidence in the solution, and a third about the process itself (more analytic or more insightful). The results, perhaps unsurprisingly, indicate that invisible hints do not result in better accuracy than no hints. False hints, on the other hand, seem to decrease accuracy. Interestingly, true (invisible) hints influence the phenomenology of insight, leading to more reports of perceived suddenness. This is interpreted as reflecting the fact that the hints influence the affective vs. the cognitive components of insight.

Experiment 3 introduces a change in the nature of the problems to be solved: Rather than anagrams, RAT problems are now used. The candidate manipulates apparently irrelevant (perceptual) features of the material so as to examine whether altering the experience of perceptual fluency influences the experience of insight.

Perceptual fluency is manipulated by having words that contain a mirrored (reversed) letter in them, making them unusual and presumably harder to process. Problem coherence is also manipulated based on material designed for an earlier study: Some problems afforded a solution (coherent problems) while other did not. People are asked to judge whether the problem is solvable or not. All participants are exposed to coherent vs. incoherent problems and to mirrored vs. normal writing problems. The results indicate that the two factors interact: Coherent problems are more often judged to be solvable than incoherent problems, and amongst coherent problems, those with normal writing are more frequently judged to be solvable than those with mirrored letters. Thus, perceptual fluency, as decreased by mirroring, influences one's intuitive judgment that a problem can be solved.

Experiment 4 builds on this by designing RAT problems that either had a correct solution or a "false" one, that is, a solution in which only one of two of the words could be associated. Both problems and their solution are presented, with the solution appearing five seconds after the problem. Perceptual fluency is again manipulated by mirroring, however, here, the mirrored letter appears during problem presentation. People are asked to judge whether the solution is correct, whether they had an insight, and how intense it was. This experiment was carried out online. There are many results; the most important one being that changing writing increases the probability that an insight is reported, which supports the core hypothesis.

The thesis closes with a general discussion, with a summary of the main findings and with a very short conclusion section.

General evaluation of the thesis

Overall, this a very good thesis in Experimental Psychology. The chosen domain —insight — is a fascinating one, and the candidate approaches it in an interesting way. He asks innovative questions about the nature of insight and the role of processing fluency in determining both the occurrence of insight and its phenomenology.

Chapter 1 gives a good overview of the field, citing both Russian and western authors, and delineates the domain and the research questions quite well. The experimental work is substantial and reports on no fewer than four experiments. Overall, this represents sufficient work to constitute a Ph.D. thesis, particularly since some of the results were published in the form of articles in Scopus / WoS referenced journal articles. The candidate demonstrates skill asking research questions, formulating hypotheses, designing experiments and analyzing their results, and reporting them.

The work leads to many questions, some theoretical, others concerning the methods used. The general strategy of manipulating visibility and asking how awareness may influence the attribution of changes in perceptual fluency, viewed here as criticial in defining the subjective intensity of insight, is commendable, if complex. It is complex because it rests on multiple assumptions that have been tested altogether in the thesis. The first assumption is that the occurrence of insight depends on perceived processing fluency. The second assumption is that changes in processing fluence will be attributed to external factors when such factors are perceived consciously, but to internal factors when no external factors can be identified. The third assumption is that invisible pictures that correspond to hints can facilitate problem solving. Those are a lot of assumptions, and a better strategy for the entire thesis might have consisted of carrying multiple smaller studies aimed at testing each.

Theoretically, one wonders about the effects processing fluency would have in "normal" problem solving, that is, in problem solving that is unaided by hints. What happens then, in terms of problem solving dynamics, has to be driven purely by internal factors. And so one's experience of insight cannot depend on external factors such as the presence of unreportable (external) hints. How does the candidate explain variations in insight phenomenology when there are no external factors that influence processing fluency? In the extant literature, authors often refer to the fact that problem solvers are sometimes faced with an impasse: They get stuck, sometimes for a long time, before accelerating quickly towards the solution. Thus, the idea that processing fluency, and problem solving dynamics in general, influences the phenomenology of insight is almost certainly correct, but what is missing is an account of how this unfolds in the absence of external hints. Surprisingly little is written or discussed about this aspect of insight, which is nevertheless fundamental as it is essentially an internally-driven process (though one may wonder indeed about the role of external stimuli, as some historical anectodes suggest).

A second theoretical issue that should be better addressed is the role of the unconscious in insight. This is addressed in Chapter 1, but it remains somewhat unclear where the candidate stands in this respect. Note that some authors, such as Nick Chater with his book "the mind is flat", deny that insight has anything to do with unconscious processing. Here, the candidate also seems to defend the idea that the *experience* of insight is in fact driven by external factors that have nothing to do with unconscious problem-solving. And yet, in Experiments 1 and 2, he seems to assume that the hints will have behavioural effects. Some clarification is needed.

Concerning the methods, a substantial issue with the work is the extent to which masked hints are truly unreportable. No evidence is offered for this claim, as there is no experiment in which participants were asked to indicate whether they could see the masked pictures. It may be the case that the pictures were perceived consciously, or it may be the case they were not perceived at all (the latter is unlikely given the results). In either case, correct method would require testing for awareness rather than assuming unconscious processing because the stimuli are masked. There is considerable debate about unconscious processing in the literatures, with prominent critics such as David Shanks having long argued that sound methods to measure awareness should always be used in any experiment aimed at documenting unconscious processing. A post-experimental interview is used to probe participants' awareness of the hints, but this fails to yield conclusive data and would at any rate by insufficient to have confidence establishing that the material is unconscious. It also raises another question: The results of the post-experimental suggest that people were simply neither informed of the presence of the pictures nor told what to do with them. Is this a problem?

A second methodological issue is the measurement of the Aha! experience. It is a pity that a single measure (a rating on a 10-points scale) was collected in Experiment 1, as there is substantial evidence that the phenomenology of the Aha! experience, as the candidate writes himself, is multidimensional. Experiment 2 helpfully addresses this limitation, but introduces new issues. For instance, why are participants asked to rate the intensity of their Aha! experience BEFORE being asked to classify the trial as analytical or insightful?

Some design choices are unfortunate or left unjustified. For instance, it is unclear why some anagrams have two solutions while others have only one. And in fact, the experimental anagrams all only have one solution — it is just that some contain a second word that cannot be an anagram solution because it contains fewer letters. On p. 66 it is reported that anagrams with only one solution were used as fillers.

Overall, M. Artur V. Allamainen is to be congratulated for his interesting work on a fascinating phenomenon. The work leaves many questions open and is not flawless, but it is carried out with sufficient skill and scholarship to deserve a Ph.D.

Thus, the dissertation by Artur V. Allamainen on the topic "*The effect of processing fluency on the Aha! Experience ratings in insight solution*" meets the basic requirements established by Order No.11181/1 dd. 19.11.2021, "On the Procedure for Awarding Academic Degrees at St Petersburg State University," the applicant Artur V. Allamainen deserves to be awarded the degree of Candidate of Psychological Science in the specialty field 5.3.1. — General Psychology, Personality Psychology, History of Psychology. No violations of paragraphs 9 and 11 of the specified Order have been detected.

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