Insight and the Genesis of New Ideas

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Research on insight problem solving focuses on the genesis of new ideas and aims to identify underpinning processes that turn an initially unproductive problem representation into one within which the solution offers itself in the agent's mental look-ahead horizon. To address this aim, researchers typically create laboratory-based tasks designed to encourage an incorrect representation of an ostensibly simple problem or riddle such as "how do you throw a ping pong ball in such a way that it travels a certain distance, comes to a dead stop and then reverses direction" (Ansburg & Dominowski, 2000). Such riddles are created to encourage an incorrect interpretation and engender an *impasse*. Researchers can then observe how this impasse is overcome by: (i) examining the phenomenology of insight; (ii) analysing strategic processing (e.g., via protocol analysis); and (iii) exploring brain areas that are active when insight arises (e.g., using neuroimaging).

The current debate in insight research (e.g., Gilhooly, Ball, & Macchi, 2015; Gilhooly & Webb, 2018) pitches the *business-as-usual* view against the *special-processes* view. The latter has roots in Gestalt ideas: insight is the result of a swift change in the way a problem is represented in the mind. The sudden awareness of the solution suggests that insight is not the product of a conscious, incremental, deliberate analysis of the problem helping the agent formulate a solution gradually over time. The 'special' in special processes underscores insight as the product of non-routine cognition largely operating non-consciously (Ohlsson, 2018). If routine cognition, in turn, is in the business of helping an agent plan and solve problems, then the business-as-usual view holds that insight is the product of conscious, deliberate, and incremental effort to solve a problem. From this perspective, a breakthrough may yield a *eureka* moment, but this distinct phenomenological signature does not imply that something other than routine cognition is involved in insight.

Insight research has laboured a fertile ground of methodological and theoretical development in the past 20 years. When the important edited volume by Sternberg and Davidson (1995) was published, research was predicated on a dichotomy whereby problems were deemed to be either *analytic* (e.g., the Tower of Hanoi) or *insight* problems (e.g., the 9-dot problem). This missed the critical point that insight and analysis are underpinning *processes* rather than solution outcomes. Developments in theory (e.g., Weisberg's, 2018, integrated framework) have underscored this point, as has the introduction of new problem types that can be solved either by insight or analysis, as reflected in self-reports (Bowden, Jung-Beeman, Fleck, & Kounios, 1995; Salvi, Costantini, Bricolo, Perugini, & Beeman, 2015; Threadgold, Marsh, & Ball, 2018). Such problems have facilitated investigations of the neural correlates of insight (Abraham, 2018; Kounios & Beeman, 2014) and associated biomarkers (e.g., eye blinks; Salvi, Bricolo, Franconeri, Kounios, & Beeman 2015). Individual differences approaches have also revealed the role of working memory capacity in insight (Chuderski & Jastrzębski, 2018). This symposium will showcase important aspects of current insight research, with presentations by Anna Abraham, Carola Salvi, Ut Na Sio, Margaret Webb, Frédéric Vallée-Tourangeau and Linden Ball (discussant).

Abraham will explore how the study of the brain informs the workings of the human mind as it arrives at insights. Functional neuroimaging studies have revealed key brain regions and networks of relevance, also highlighting the intimate roles played in insight by creative processes such as analogical reasoning and conceptual expansion. EEG studies using event-related potentials indicate a unique neural activity pattern when processing creative associations that are personally experienced as being novel and fitting, as distinct from processing associations that are merely novel or merely fitting. In addition, neuropsychological studies indicate that disruptions at the level of brain structure can both aid and impede creative thinking. The former occurs in contexts where distractibility facilitates creative ideation, a finding indirectly supported by personality-based studies of schizotypy and creativity. These results highlight the value of the neuroscientific approach in advancing an understanding of how creative insights come to pass.

Salvi will present her findings on the "accuracy effect" (i.e., insight solutions have a higher probability of being correct than analytic solutions when tested using convergent thinking problems) and will discuss the model behind this result. The effect is explained by the fact that insight processing yields no partial solution information because of subthreshold processing prior to the suddenly available solution. In contrast, analytic processing can yield better-than-chance guessing based on processing of suprathreshold activation candidates. Further, Salvi will present her latest results on the neural correlates and biomarkers associated with insight solutions and the underlying cognitive processes.

Sio will focus on the circumstances that promote creativity. Despite the common belief that distraction will cause productivity loss and that individuals should focus on a single task to achieve optimal performance, recent studies have demonstrated that distraction (e.g., incubation and multitasking) can enhance performance for problems requiring creative thinking. Different potential mechanisms for this distraction effect will be discussed. Sio will also present findings of recent studies aimed at identifying moderators of the effect to help explain why the positive effect of distraction might emerge and to identify the conditions under which distraction becomes facilitating.

Webb will present research on individual differences associated with insight phenomenology. Investigating individual differences in possible biases in reporting insight is constrained by the "problem of problems", that is, problem-solving skills (e.g., working memory) are required for insight problem solving itself. These individual differences may not be the same as those associated with a bias towards insight experiences. In her recent work, Webb has explored divergent thinking tasks, in which subjective accuracy is high. Participants completed a form of the alternative uses task, reporting on their insight phenomenology ("aha!" experiences) in a trial-wise manner. They were then presented with various solutions to the previous task and also completed a measure of schizotypy (the O-LIFE) to assess whether positive schizotypy (associated with the tendency to perceive meaning in noise) predicted a tendency to report feelings of insight. Findings indicate that generating a use is significantly more likely to result in an "aha!" experience than being presented with a use; positive schizotypy is also a positive predictor of feelings of insight.

Vallée-Tourangeau will outline an ecological perspective on insight, critically reflecting on how insight research often proceeds in the laboratory and how the psychometric methodology validates and reinforces a model of problem solving in which working memory plays a central role. His reflections draw on a distinction between *first-order* versus *second-order* problem solving (Vallée-Tourangeau & March, forthcoming). Research typically assumes the world is represented *inside* a person's head, with mental representations being transformed by rules and operators. It is, therefore, not surprising that individual differences in working memory capacity explain a substantial proportion of the variance in problem solving performance, as working memory underpins a person's ability to construct, maintain and transform mental representations. Crucially, the standard methodology requires participants to think about short vignettes (a few words or sentences) that describe (ambiguously) some state of the world. In other words, participants are not embedded in the *physical* world to solve a problem (first-order problem solving) but are instead processing representations of the world based on abstractions of varying complexity (second-order problem solving). First-order problem solving is impossible as participants cannot interact with a *physical* problem presentation. Second-order problem solving carries a representational toll and, as a result, individual differences in the ability to maintain and transform mental representations—gauged in terms of working memory capacity—correlate with problem solving performance.

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