

Abstract

This article challenges the traditional view of progress from ignorance to knowledge, arguing that creative cognition involves an extended and dynamic system of possibility generation. It emphasizes the importance of an externalist approach to possibility generation, which takes into account the role of objects in the environment in shaping cognition. Accidents are seen as a key trigger for creative thinking, as they disrupt planned cognitive trajectories and introduce novel elements into the cognitive ecosystem, leading to new possibilities that were previously inconceivable. However, how we filter these opportunities is rarely explored. The feeling of impasse, when problem-solvers are stuck and unable to find a solution, is also explored as an important generative state for creativity. While this state may be unpleasant, research suggests that persevering through it can lead to a sense of "aha" and may be actively sought out by creatives. The article concludes that further research is needed to fully understand the relationship between aversive states, chance, and human imagination in order to unleash the full potential of creative thinking.

The Possibilities of Disruption: Serendipity, Accidents and Impasse Driven Search

The tradition of modernity embraces a linear notion of progress from unknowing or an uncomfortable state of ignorance to knowing (Arfini, 2019). This underlies the imagining of how possibilities are produced: along with an increase in knowledge comes an increase in possibilities. Consider the role of science in opening up the possibilities of movement, from the internal combustion engine to the ability to travel beyond the earth's atmosphere. Linear progress here is a metaphor which underlies much of our instinct about how possibilities come about and reflects an underpinning philosophy that people can access an disembodied intellect (Lakoff & Johnson, 2010) and that through reasoning they can produce knowledge and tame the non-linear natural world (Ingold, 2007). Under this model, we rely on so called higher cognitive processes to drive linear progression and so to increase possibilities (Escobar, 2023)

It is my contention that this metaphor of a direct move from unknowing to knowing through the accumulation of knowledge and the steady erasure of ignorance frustrates our understanding of how new ideas are formed and new possibilities are generated. This paper consists of three related arguments. First, that a theory of isolated human intellect is the least parsimonious explanation¹ for the sort of cognition which is theorised to generate possibilities – creative cognition. Rather, creative cognition is best understood as part of an extended, dynamic system of possibility generation spread across people and things. Second, that, a replacement that posits an open cognitive system over which the human agent does not have full direct control, undermines that notion that a linear increase in human centred knowledge is the best way to new possibilities. Rather, it is through the *disruption* of these linear trajectories, the exposure of ignorance, that we can move from adjacent to far possibilities. These moments of disruption are serendipitous in nature requiring both material agency and human sensemaking. These two considerations forefront failure and discomfort in the phenomena of creativity and serendipity. The importance of this discomfort will support my final point that impasse and uncertainty should be embraced as generative states rather than ones to be avoided.

¹ My own beliefs are that it is not possible (a) for a human agent to think outside of an embodied, culturally and materially rich situation (Lakoff & Johnson, 2010) and (b) even if such a thing were possible, that truly new thoughts would not arise but I am willing to concede this argument in favour of a pragmatic approach to what is most *likely* to happen in the world and also what is the most parsimonious explanation.

The Implausibility of Possibility Generation

Possibility generation is not traditionally listed in the so called higher cognitive processes, but it arguably underpins those such as problem solving, decision making and creativity (see for example Byrne, 2023; Ormerod, 2023). The focus of this paper is the domain of creative cognition given that the existence of creativity is theorised to be dependent on possibility generation (Faggin, 2023). I shall start by outlining the traditional mentalist approach to creative cognition (Vallée-Tourangeau, 2023) that also underlies folk theories of possibility thinking before showing how an externalist approach is more plausible and thus, more parsimonious. I make the claim that most cognitive theory proceeds from an internalist perspective because most research in this area, even that that recognises the importance of social interaction, does not take account of the way that the environment and things shape cognitive processes (Malafouris, 2020).

Thinking about possibilities involves two opposing but essentially complementary processes: ideal possibilities and real possibilities or tame and wild (to borrow from Glăveanu (2022)). The tamer of the two develops possibilities in terms of the *probability* of an event and undergirds processes such as decision making, planning and problem solving. It is an essentially future oriented, action dominated mode of thought – if I were to *do* x or y, what are the probable outcomes? Thus, it is rooted in a pragmatic albeit projected reality. For example, when assessing places to go on holiday, this form of thinking will build on prior information to select which is the most probable to achieve the intended goal. This way of thinking is rooted in prior knowledge and so relies on projecting and evaluating adjacent possibilities, that is the world which is very close to the actual (Björneborn, 2023). It is mainly reliant on two of the four modes of possibility thinking as outlined by Glăveanu (2023), that is ‘what could be’ and ‘what is to come’.

The second process, the wilder version, is the generation of previously unconsidered possibilities with varying levels of probability but generally improbable (hence the wild). This imaginative process is generally linked to creative cognition and while it may generate some of the possibilities assessed in the tame version, it is not based in nor constrained by reality – the two forms of possibility thinking it draws on are ‘what could have been’ and ‘what is not or can never be’. When using this form of thinking to select a holiday, what is generated are a series of possibilities that do not take into account pragmatics such as cost or timing, rather they are not constrained by the exigencies of reality. Indeed, often the point of such thinking to fantasise about things which have no basis in reality. This second form of

possibility thinking importantly includes disjunctive possibility, the possibility of non-being (Poli, 2023). If there is no possibility of impossibility, then the possible becomes the certain and ceases to exist. Therefore, wild possibility requires impossibility.

This distinction is broadly analogous to the role of divergent and convergent thinking in innovative thought processes. Divergent thinking is concerned with how we generate creative ideas while convergent thinking investigates the selection of a wide range of ideas for what will attain the goal. Again, much like convergent and divergent thinking, while the distinction between tame and wild modes of thought seems initially to be oppositional they are actually complementary. Indeed, these two forms of thinking combined allow us to generate pragmatic possibilities which move beyond our initial understanding of a situation. Possibilities which are generated through imagination stay in the imagination, possibilities which are only based on past probabilities remain rooted in that past. Future oriented possibilities require both. The magic of possibility comes through making real that which appeared to be “only” imaginative thus collapsing the distinction between the two modes. It is only through instantiation and becoming tame that the possibility of impossibility can be adjudicated (Crilly, 2023).

How we generate these possibilities whether wild or tame is of increasing interest to a wide range of researchers (Ross, 2023). From a traditional perspective, the movement from lack of possibilities to wide array of possibilities is simple, linear and, crucially, internal. The emphasis on the imaginary, impossibility and non-existent objects (Valsiner, 2022) forces us out of the world and into the head. On this view, we *think* of as many things as we can deploying such structures as semantic memory networks (Benedek et al., 2023). Following from this, if we can think it, we can create it; we can turn the wild possibilities into tame ones and erase the notion of impossibility. Wild possibilities therefore are to be encouraged as the place of novelty and wild possibilities carrying with them the possibility of non being are not of this world. However, this leads to a paradox succinctly summarized by Ohlsson (1992, p. 1) in relation to creative cognition:

The main puzzle of creative cognition is that it can produce novel concepts, beliefs, problem solutions and products that are not in anyone’s prior experiences. How is this possible? Where does the novelty come from?

This requirement for creative cognition to build on concepts, beliefs or problem solutions that are not in anyone’s prior experiences is a strong form of creative cognition but one which underlies much psychological theory in creativity (Ingold, 2022). Boden (2004) identified

three processes underlying novel thoughts: new combinations of existing concepts or artefacts, exploration of existing conceptual spaces, and transformational thinking which rapidly expands or breaks through the existing conceptual boundaries. It is this latter form of thinking, which is so vexingly opaque and yet which is closest to the wild form of possibility thinking and arguable the only one that leads to true novelty

I shall begin by laying out two key problems with the view that when it comes to generating possibilities, a methodologically individualistic approach will be the most profitable. Both problems stem from observations in and outside of the psychologist's laboratory (e.g. come not from what people should do or are even capable of doing but what they actually do in their lives in the world. Much of cognitive psychology isolates idealised processes and with a Fodorian solipsism ignores the surrounding environmental structures that elicit that behaviour (Gozli, 2017; Ross & Vallée-Tourangeau, 2021c). This leads to a focus cognitive states that while being achievable and possibly even advisable do not reflect thinking *in the world*.

The first problem with a mentalist approach to possibility generation is that thinking is an effortful process and people are cognitively miserly (Ormerod, 2023). Cognition is expensive and it is unclear how much people generate possibilities in a day-to-day way without the sort of in-lab prompting that accompanies most data on these situations. Take for example, a traditional measure of idea generation used in the psychologist's laboratory: the alternative uses task. This task invites participants to generate as many alternative uses as they can for a given object. Participants tend to be relatively poor at generating possibilities with the average coming up with around 2 a minute and those that have ever administered or coded the answers from an alternative uses task will testify how mundane these answers can often be. Possibility generation is cognitively expensive and without explicit scaffolding, wild thinking of the kind needed to generate changing possibilities seems vanishingly rare. Therefore, even if we were to pin down and even improve underlying processes of idea generation, it is not clear how many more ideas that would lead to in everyday thinking.

Indeed, this may even be beneficial. Take successful models of creative problem-solving such as Ormerod et al's (under review) PRODIGI model. The model works very simply: When the solver reaches criterion failure (that is they are at an impasse and can no longer progress) they look back at previous attempts and try to find concepts by seeing similarities and differences between move attempts, and they use these concepts to generate novel move types. The model is very successful at solving insight problems which are considered, theoretically, to only be able to be solved by the kind of abductive leap which

mark the generation of a new thought and a wild possibility. However, PRODIGI only models what is in the problem statement or discovered as a result of attempting to solve the problem. It cannot model the sort of breakthrough thinking which characterises a leap from the adjacent possible to the distal possible. This then reflects a systematic assessment of possibilities and the creativity captured by Boden's (2004) theory of conceptual exploration. It is remarkable successful at predicting human performance. On the other hand, when faced with a problem of the sort modelled by PRODIGI, a model of wild possibility thinking might indulge the kind of imaginative thinking which doodles faces on a set of dots and generates a whole story about a family of ferrets trapped in a milk crate easting jelly babies and singing Elton John. It is unclear how useful this would be.

Even this latter, while undoubtably creative, rests on a combination of concepts and artifacts that are already in the problem solver's cognitive system. We are still at the level of combinatorial rather than transformation creativity to call again on Boden's taxonomy. There is nothing novel about milk crates, jelly babies, ferrets or Elton John². The novelty of this image lies in the act of combining the concepts. People often find it very hard to break free from learned concepts and models. Ward (1994) describes how human imagination is fundamentally structured which means that even extra-terrestrials generated with no explicit constraints mirror fundamental human attributes. Such fixation on prior knowledge often characterises problems in design and frustrates innovative solutions to problems (see Crilly, 2019, for a review of case studies in design fixation). In other words, a focus on the individual, internal mechanisms that underlie possibility thinking may come to the conclusion that the easiest way to solve Ohlsson's puzzle is that people do not come up with the kind of transformational breakthroughs that mark this form of wild thinking and that when they do it may be so rare as to be empirically intractable.

I would suggest, therefore, that the most parsimonious answer to Ohlsson's puzzle is that the cognitive system is opened to incorporate new knowledge from external sources and that epistemic credit becomes distributed (Ross & Arfini, 2023). In this case, to return to our original example, the possibilities of a holiday are enhanced by a search engine that is given pragmatic parameters but draws from a wider range of destinations to suggest places which were not in nor reliant on the holiday makers' original thought processes. This can be socially distributed across other people mediated through technological advances. This is not a new

² At one moment in time, Elton John was undoubtably novel but as the generator of this image, I can assure the reader that I was not responsible for that novelty.

proposition of course. There are several challenges to the view that cognition is a purely mental process with varying degrees of cognitive agency being granted to those outside of the skull boundary (see Bruin et al., 2018; Menary, 2010). In this case, rather than being closely aligned to the tamer forms of possibility thinking, reality becomes a triggering cause for wide and fertile possibilities (Hanchett-Hanson, 2023). To borrow from Hamlet: “*There are more things in Heaven and Earth, Horatio, than are dreamt of in your philosophy.*” (Hamlet, Act1, Scene 5). In other words, the best way to come up with truly novel and transformational thoughts is to incorporate things that are not already in the cognitive system of the thinker.

This opening up of the cognitive system makes all the forms of creativity outlined by Boden closer to the wild, disruptive form of possibility thinking with a much lower cognitive effort required removing the incentives to stay with what is already known. Take for example, combinatorial creativity. The cognitive load of combining different objects mentally is enough that while it may be that the imagination would function better without the associated constraints of reality, in a combinatorial task having actual objects to play with inspires people to create more creative products (Shimizu & Okada, 2021). Playing with the real means that combinations which have no roots in memory or experience can be generated and these may break creative fixation (Vallée-Tourangeau et al., 2011). These may also act as sparks for breakthrough thinking reversing the traditional direction of imagination to creation (Ross & Webb, in prep).

Importantly in understanding how this space between possibilities is bridged, –while it is the encultured³ human mind which makes sense of these material sparks and directs their implementation, it is not the individual human agent who is fully responsible for the cognitive act that generates that space. This distribution of agency can be achieved by making a distinction between cognition as a process of generating knowledge and the *sense of cognition* as experienced by a human agent. Rather than seeking a mark of the cognitive (Adams & Aizawa, 2001), I suggest it is in this sense which can differentiate human and non-human actants. This reflects the rhythm of online and offline thought which often distinguishes thinking in the world (Bocanegra et al., 2019). This is not trivial⁴, this understanding fundamentally directs our attention as cognitive scientists out of the mind into

³ Just as cognition is distributed, so sense making cannot be understood without reference to the surrounding culture which works in dynamic flow with the creative mind – culture shaping the mind but creative products also shaping and changing the surrounding culture.

⁴ Although it is worth noting that there are some debate which cannot be solved empirically and which become trivial from an empirical perspective although deeply important from a metaphysical one such as the debate between embedded and extended cognition (Kirchhoff, 2012).

the mind-in-the-world. Once this shift in perspective has occurred then some of the contradictions of creativity and possibility are not as paradoxical as they first appear but are rather caused by an underlying and misplaced assumption that the *sensemaking* agent is the same as the *cognising* one. Rather, a more transactional perspective on thought sees it as reflecting not just the intentions and agency of the sensemaking person but as emerging from the engagement with the world and takes seriously the cognitive agency of things outside the brain – thus positing a model of finely grained co-collaboration. Most important for the argument here, things bring knowledge and possibilities into the cognitive system that were not there before.

Distributed Cognitive Agency: The Implications of Accident

If we open the cognitive system to incorporate people⁵ and things outside of its traditional boundaries we quickly encounter instability and empirical messiness. It is precisely this instability which led Simon (1965) to reject the environment in understanding human problem solving. For Simon, the environmental complexity makes it harder for us to deduce what is ‘cognitive’ and what is environmental. It is not that the external world was, or continues to be seen as, irrelevant—indeed it is trivially true to suggest that thinkers are embedded in a context—but rather it is not necessary to understanding the rule-governed structure of human thought and, perhaps more important, will act as a complication to the discovery of these universal laws⁶. Therefore, according to Simon, the proper task of psychology is to only focus on those things which are not attributable to the environment or socio-cultural forces.

However, even in the controlled environment of the psychologist’s laboratory⁷, cognitive agency spills out of the person (Ross & Vallée-Tourangeau, 2021c). I suggest therefore that only focusing on the individual falls foul of the mereological fallacy. Mereology is the study of part/whole relations and this fallacy refers to ascribing to a part what is properly only ascribable to a whole. The underlying ontological assumption of mereological composition is that the whole is the sum of its parts and nothing more and that through the process of composition or decomposition the parts remain the same. Rocca and

⁵ Over the course of this paper, I shall address the role of non-human actants in the disruption of linear potential but the argument applies equally to cognition distributed across people and time

⁶ Not, note, a theoretical choice but a pragmatic one. Fodor has a similar practical objection to moving outside of the head: “[...] there’s no practical hope of making a science out of this relation. And of course, for methodology, practical hope is everything.” (Fodor, 1980, p. 71).

⁷ See Ross & Vallée-Tourangeau (2021b) for a longer discussion on the fallacy of the unsullied lab

Anjum (2020) compare it to building a model with Lego bricks: There is a logic to an analysis of the bricks as separate items in order to understand the whole model because the bricks remain unchanged throughout the process. This same logic underlies the isolation and examination of individual cognitive processes. As I have demonstrated, an internalist perspective relies on the importance of internal states so that changes in the outside environment are mirrored by changes in internal dispositions and so this environment can be ignored. It is this position and the concomitant mereological assumptions which dictate the level of analysis of the research into cognitive processes. If, however, the Lego bricks were malleable and changed during the building process, assessing them at the level of the brick would be meaningless because what would be of interest would be the shape and composition during building. What I am proposing in this section is that things in external environment – not the people nor the socio-cultural milieu – are constitutive rather than scaffolding of cognition and therefore deserve epistemic credit.⁸

Agency and intentionality on this view are cast as “open” concepts which arise in action rather than a universal and identifiable essence. I follow both Malafouris and Pickering (1995) in this understanding. Malafouris (2013, p. 149) writes that “Agency and intentionality may not be innate properties of things, but they are not innate properties of humans either; they are emergent properties of material engagement”. I am aware of the controversy that can lie in endowing inanimate objects with agency but choose here to use this term to indicate their active involvement in human cognitive processes.

I shall focus primarily in this section on the role of accidents because they are the moment when cognitive agency is most clearly situated outside of the person and will be the strongest proof for my argument that epistemic credit should be distributed across material objects. This moves us away from a model of extended cognition which is based mainly in cognitively offloading (Risko & Gilbert, 2016) to one where material agency is not passive and recruited by the cognitive agency but rather is generative. An accident is necessarily disruptive, unexpected and beyond prior control⁹. In this way, they are the instantiation of the wild possibilities – they are marked by surprise because they have not been conceived of prior to their occurrence. In the research summarized here they are epistemically loaded – that is they bring with them their own knowledge - and arguably cognitive – that is they demonstrate processing - although disconnected from the sense making which often

⁸ This is not to say that other people or the social cultural environment is not important. It is. Simply that the focus on this paper is on the implications for cognitive psychologists of this opening.

⁹ This is a simplistic view of agency in relation to accidents. For a fuller discussion see Ross (2022b)

accompanies it. In these instances, knowledge is not generated through *a priori* thinking and consideration but rather reflects unplanned and unintended changes in the environment¹⁰.

In other words, I wish to make the distinction between material agency as a causal or as an enabling factor. A model of extended cognition based on offloading is useful to understand how we interact with objects in cognitively demanding tasks but is more correctly described as a scaffold. The triggering nature of the accident means that we cannot trace full cognitive responsibility back to the internal workings of the thinker's brain. This interaction between the triggering accident and the subsequent human sensemaking is more often known as serendipity (Arfini et al., 2018; S. M. Copeland, 2019; Ross, 2023). I have elsewhere (Ross, 2022b) outlined what makes the accident serendipitous. First, it is firmly embedded in action, normally non-directed actions on and with objects. Second while unintended, the results of the actions are both noticed and generate surprise. Human sensemaking is involved to understanding the implications of the trigger. Third, it causes a change in the mode of thought and breaches conceptual boundaries, introducing something novel to the cognitive system. A serendipitous accident is also a situated accident. It cannot be understood without a reference to the state of the broader surrounding system before it occurred, and it is only serendipitous if it is later enacted. This means we keep the sequential nature of human action while still maintaining that some aspects are unexpected and unpredictable.

When participants are provided with cognitive artefacts to scaffold their thinking, the idea of accidents is often mentioned¹¹. Fioratou and Cowley (2009) describe a version of the cheap necklace problem¹² and suggest that 6 of the 21 solvers (almost a third) solved the problem through the exploitation of an accident. This same observation occurs in Chuderski et al., (2020, p. 18) who suggest that “in the matchstick algebra problem, it is arguably easier to arrive at the solution by accident or trial and error, for instance by realizing as a result of a random movement of a stick that it could act as a negative sign.” Ormerod et al. (2002) invited participants to solve the 8-coin problem using hexagonal coin tokens and write of

¹⁰ There are times when accidents are actively rather than passively sought as pointed out by a reviewer of this paper. This happens in creativity such as [Du Champ's Three Standard Stoppages](#). In this instance, the accident is epiphenomenal to the main event rather than triggering.

¹¹ While I have undertaken my own research which specifically focused on accidents (Ross & Vallée-Tourangeau, 2021a, 2021d) as has Kirsh (2014) and Gavurin (1967), I think it is profitable to survey the literature where it was not expected to demonstrate its ubiquity, however I point the interested reader to these papers where chance was more explicitly manipulated.

¹² The cheap necklace problem requires participants to make a complete closed loop (necklace) out of 12 links of chain, with the starting point being 4 smaller, 3-link chains. A cost constraint (2 cents to break a link, and 3 cents to join a link) is imposed. The correct solution involves breaking all three links of one of the 3-link chains, and using the individual links to connect the three remaining linkchains together

“serendipitously encounter[ing] an external object or event” (p.797). In one of the few qualitative approaches to insight problem-solving, Steffensen et al. (2016)’s finely grained analysis of another in lab problem solving experiment demonstrates that the solution hangs on an accidental moment. It is so prominent in Fleck and Weisberg’s work that they coin a phrase for it “data driven restructuring” (2013, p. 452)¹³ which underlines the triggering nature of the accident. These accidental revelations dismissed through an aside in many papers undermine a linear, disembodied and unsituated model of cognition.

If new possibilities can be generated through accident in the controlled environment of the laboratory, then how much greater is the likelihood that they will occur in a materially rich situation? Qualitative research in creativity (Glăveanu et al., 2013) shows us their importance: For the artists “accidents enrich the project and one needs to constantly be on the alert for them” (p. 5), for designers “creative activity is a game [...] of ‘happy’ accidents” (p. 7), for scientists: “there is in science room for accidents and surprises” (p. 8) and for musicians: “accidents play also a role in this process, and they are ‘artistically interesting to have’” (p. 11). The role of accidents in the creative process was also emphasised as a key emergent theme by Sawyer (2018) in his qualitative work on the creative processes of MFA students (see also Ross & Vallée-Tourangeau, 2020).

The proposal here therefore is that accidents should be taken seriously as a trigger of wild possibility thinking and indeed as being more plausible than the notion that wild possibility thinking can only happen in the head. Through serendipitous accidents, imagination in the form of human sensemaking is enhanced by the abrupt introduction of an unanticipated disruption to a planned cognitive trajectory. This moment is one where the external world intrudes on internal processes and derails them. It is this unplanned and intrusive nature that grants accidents cognitive status beyond a passive stimulus.¹⁴ This

¹³ “Data-driven restructuring included instances when the individual changed his or her representation of the problem in response to something he or she saw from the physical configuration of the problem [...]. Observations occurred as the participant was attempting to construct or implement another heuristic-based solution”

¹⁴ I shall borrow from Clark and Chalmers (1998) and generate a similar thought experiment. Scenario One: A human agent sits in front of a computer screen and mentally simulates the moves matchsticks from one place to another until she falls on the answer. This internal movement is recognisable as cognitive and modelled in models of problem-solving involving trial and error. Scenario Two: The agent intentionally shifts the display and better “see” the answer. The changing of representations is no longer internal but external and the actions are no longer mental simulations but movements in the world (Kirsh & Maglio, 1994; Vallée-Tourangeau et al., 2016). Scenario Three: The movements are aimless (fiddling) but they shift and change the array such that the epistemic landscape is altered and the answer become obvious. Finally, Scenario Four, the movement is generated by a randomiser and is a pure accident. From an extended functionalist perspective (Wheeler, 2010) each move is the same, the difference is the intentionality of the human agent and the location of the thinking. We naturally resist assigning cognitive functions without concomitant intentionality but if we require intentionality for all cognitive functions then more will be removed from the definition than will be preserved.

interruption forces a noticing¹⁵. This emphasis on disruption stops creative flow, forcing “moments of distance and reflection” (p.7). Indeed, there is some evidence that full creative alignment with the material does not allow for accidents (see for example March & Vallée-Tourangeau, 2022). Thus, accidents are necessarily disruptive, and it is this which grants them their generative power because they introduce to the cognitive ecosystem that which has not been previously considered. That they are accompanied by the epistemic feeling of surprise is important,

The Importance of Impasse and Ignorance

I have discussed the implausibility both from a logical and empirical view that human’s generate wild possibilities through internal thought processes. I suggested that the answer to Ohlsson’s puzzle was the opening of the cognitive system to those outside of it. The implications of this are that accidents can be seen as a more plausible way of generating wild possibilities – that is possibilities that breach the inconceivable and I have assessed the empirical evidence for their role both in and out of the laboratory. However, under this situation, the direction of cognitive cost is reversed. An internalist model requires the human agent to generate and then filter wild possibilities, the model I have proposed generates the possibilities but also needs to filter them. , This where the human agent as sense maker become important to a full understanding of the possibilities that arise through accident. Those things which are out of our control are part of the daily weave of human life without our noticing or recognition. Similarly, we do not career from moment to moment, as passive receptors of ideas from random combinations. Indeed, we know from empirical research that the positive aspects of *noticed* accidents and hints are actually rarely exploited by the problem solver (Ross & Vallée-Tourangeau, 2021a, 2021d) although subliminal hints can be (Hattori et al., 2013). In fact, we do not know much of what determines whether these accidents are enacted or not. I suggest that it is here that research efforts should be concentrated to understand how accidents are selected to support the generation of possibilities.

Seifert et al (1994) have put forward the hypothesis of the prepared mind based on the theory of opportunistic assimilation in which they discuss the idea that previous unsuccessful problem-solving attempts leave failure indices which are likely to be triggered by relevant

¹⁵ There is a tricky circularity here, the accident can be described as the triggering cause which may serve to set in motion the act of noticing yet it is the act of noticing which grants the intrusion its accidental status. Human and environment are not easily disentangled

environmental information. They suggest that an impasse is the most important phase of opportunistic assimilation because it is here the foundational memory traces are laid. Impasse is the state when the problem solver has exhausted the search space for problem solutions – more prosaically, she is stuck (Ohlsson, 1984; Shen et al., 2019). In this state the agent is aware of her shortcomings and is unable to resolve that epistemic abyss through continued cogitation. Anecdotally, we often see that material agency is invited in – often generated by a series of actions such as fiddling or unintentional and aimless trials which repeat the same wrong answer (Fleck & Weisberg, 2013; Ormerod & Gross, 2023). Even, as suggested by a reviewer, in more esoteric practices such as the I Ching. In impasse the problem solver is motivated to know the answer but no longer knows how to uncover it - she is in a state of aching ignorance (Arfini, 2023). It is theoretically plausible cognitively and affectively that this is the state that makes problem solvers most aware of hints and open to environmental contingencies and indeed, there is empirical evidence to suggest that this moment is important (Moss et al., 2011).

The feeling of impasse is unpleasant. In early work I am conducting with Selene Arfini (Arfini & Ross, under review) we have collected reports on the feeling of beings stuck and for many it has an overwhelmingly negative valence. Yet, the experimental stimuli we are using are riddles – a form of mind game that is popular across different levels of society and cultures. Such games rely on their effectiveness on the ability to induce impasse. It seems that it is not the feeling of impasse that is important but the response to it – for many impasse simply leads to giving up but for those that persevere it can lead to an increase in the feeling of “aha” relative to not experiencing it. The stimuli in this case are from a class of riddles known as stumpers (Bar-Hillel, 2021) which differ from other riddles because they rely on the reader suppressing the dominant mental model they have generated in their mind rather than working through something cognitively demanding. They are therefore laced through with uncertainty. Normative data reported in Ross and Vallée-Tourangeau (2022) suggests that the average confidence levels that even correct answer inspired in the solvers was 63% and for hard problems this dropped to only just over the mid-point, 54%. However, when we (Arfini & Ross) asked participants if they wanted someone to tell them the answer, those who most enjoyed problem solving regularly were significantly more likely to say that they would rather not be told the answer. Much like being told the end to a mystery novel or a detective film being given the answers appears to reduce enjoyment (Anderson et al., 2019). So, while this feeling initially appears to be negatively valenced, this negative valence is not necessarily negative overall to performance. Indeed, there is some evidence that the tolerance of this state

of uncertainty is not only beneficial for creatives but also actively sought out by them (Bardt, 2019; Beghetto, 2021; Ross, 2022a) suggesting that the state of impasse may be an important generative state.

Concluding Remarks

Wild possibilities expand the “here and now” into the “there and then” by expanding into spaces that they have not encountered before. The perspective of cognitive psychology is that these possibilities are envisaged by a mind in a closed and disembodied system. It privileges the flash of insight over the discomfort of impasse. This paper has argued that this faith in isolated human reason has two problems – human reasoning capacity is limited and is fixed by what comes before. The sort of wild thinking that characterise transformational creativity seems limited and relying solely on isolated human reason may limit our ability to break conceptual boundaries. Therefore, rather than being free of the constraints of reality, imagination is fixed by it. The most efficient model for the breaking of conceptual boundaries is a model which includes interaction with the outside world. Under this model, we can cast accidents as triggers for wild possibility. Accidents provide unexpected and unplanned moments of inspiration that, combined with human sensemaking are triggering causes of transformational creativity. However, we live in a flow of accidents and environmental affordances, yet research is scarce on the how we best enact these. Further research is necessary to better understand the relationship between aversive states, chance, and human sensemaking in order to fully explore the vast potential of human becoming.

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