Insight Out: Creative Problem Solving beyond Folk Psychology

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Abstract

The folk psychology of creative problem solving relies upon mental states to explain everything from the outcome of problem-solving experiments to the emergence of artistic creativity. We present two converging perspectives that describe a profoundly different ontological description of creativity. First, we review recent experimental research to demonstrate the poverty of a psychometric model of problem solving that is based upon cognitive or dispositional capacities. Instead we show that, if mental simulation is replaced by the opportunity to engage with a physical model of a problem, then the environment can provide affordances that help the participant to solve problems. Second, we present the subjective experience of an artist as he monitors the micro-decisions that occur during the morphogenesis of a large, clay, sculptural installation. The testimony is a vivid demonstration that creative action occurs, not in the brain, but in the movement between the hand and the clay. Insight becomes outsight.

Insight Out: Creative Problem Solving beyond Folk Psychology

It would be difficult to overstate the importance and influence of Wolgang Köhler's (1927) "The mentality of apes" on the psychology of problem solving, insight and creativity. As a nascent scientific discipline, psychology was embracing behaviourism with its associated methodological and ontological proclivities, yet Köhler's ethological observations and inferences were couched in mentalist terms. Problem solving in these chimpanzees was not described in terms of the concatenation of stimulus-response sequences through gradual associative learning. Rather, some of the solutions to the problems engineered by Köhler for these animals appear to reflect insight, a sudden discovery of a path to solution. Sultan was one of Köhler's star performers. In one instance, Köhler nailed a banana to the roof of an enclosure, 2 meters from the ground. A 50 x 40 x 30 cm box is placed in the middle of the room; the banana is 2.5 meters from the box. Köhler writes (p. 41): "Sultan suddenly stood still in front of the box, seized it, tipped it hastily straight towards the objective, climbed upon the box and springing upwards with all his force, tore down the banana." In what would be called the Gestalt account of insight, a solution reflects the sudden reconfiguration of perceptual elements. The mental representation of the problem is initially misaligned with the representation of the goal. The tension between these mental representations trigger unconscious processes that seeks to harmonize these two representations, to create a good gestalt (Gilhooly & Webb, 2018).

The current science of insight problem solving in particular shares a lot in common with this initial theoretical account. Animal ethology no longer prefigures so centrally of course, and an experimental methodology is largely favoured over single case studies, but the aim is to identify the cognitive processes that turn an initially incorrect or unproductive problem representation into one within which the solution offers itself in the agent's mental look ahead horizon. To forego the cost and patience involved in observing people's problem solving outside the lab, cognitive psychologists create miniature problem solving environments designed to encourage an incorrect representation of an ostensibly simple problem or riddle. In the psychologist's laboratory, insight problem solving research proceeds usually by presenting participants a riddle, such as "the thing that can move heavy logs, but cannot move a small nail" (Luo & Nikki, 2003, p. 317), or 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 (to adapt, Ansburg & Dominowski, 1980) or "if you have black socks and brown socks in your drawer mixed in the ration of 4:5, how many socks do you need to take out to be sure of having a pair of the same color" (Fleck & Weisberg, 2013, p. 446). These riddles are created to mislead, to encourage an incorrect interpretation that will frustrate the direct application of long term memory knowledge to identify a solution. To create a conceptual impasse is the point, of course, and then researchers observe how the impasse is overcome. A minority of participants will eventually say, 'river', 'vertically', and '3 socks', but most will labour fruitlessly until the end of the allocated time (usually a few minutes). Using a broad range of measures, psychologists are interested in the phenomenology of insight (for those who experience it), neuroimages of areas that are more active when an insightful solution is achieved, or the conscious analytic strategy revealed through protocol analysis.

The current debate in the psychology of insight problem solving (e.g., Gilhooly & Webb, 2018) involves the so-called business-as-usual view against the special-processes view. The latter has roots in early Gestalt ideas: insight is the result of a swift change in the manner with which a problem is represented in the mind. The sudden awareness of the solution suggests that insight is not the product of a conscious deliberate analysis of the problem, proceeding incrementally, helping the agent formulate a workable solution gradually over time. The 'special' in special processes underscores that insight is the product of non-routine cognition that largely operates non-consciously (Ohlsson, 2018). If routine cognition, in turn, is in the business of helping an agent to 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 well yield a eureka moment, but that distinct phenomenological signature does not imply that something other than routine cognition is involved in insight.

Psychometrics

If insight is the result of unconscious thinking, then working memory, as the conscious mental space over which people mentally manipulate, rehearse, store relevant information when thinking, might not be implicated in insight problem solving. In turn, the business-as-usual view holds that a participant’s working memory capacity and executive function skills should predict that participant’s ability to solve insight problems. Researchers employ a correlational psychometric approach to test these ideas: participants sit through a laboratory session composed of insight problems and various working memory capacity tests. Performance on these insight problems—usually measured simply in terms of the number of correct answers—is correlated with performance on working memory tests. For example, Gilhooly and Fioratou (2009) reported that measures of verbal and visuo-spatial working memory explained a significant portion of variance in insight problem solving. This suggests that people’s ability to solve the riddles that are offered as insight problems, correlate with working memory capacity, which in turn correlates with measures of intelligence (Chuderski & Jastrzębski, 2018; Oberauer, Schulze, Wilhelm, & Süß, 2005). These data support the psychometric model of insight problem solving. Such a model explains creative problem solving in terms of an agent’s cognitive capacities: The better these capacities the better positioned an agent is at solving problems.

Let's pause and consider how the research on insight problem solving proceeds in the laboratory and how the research methodology validates and reinforces the psychometric model of problem solving. The dominant research paradigm is erected on the twin pillars of mentalism and methodological individualism. The research proceeds on the assumption that the world is mentally represented and that these mental representations are transformed on the basis of rules and operators. These representational processes are located inside the person, or more specifically, the person's head. It is not surprising, therefore, that the psychometric model of insight problem solving has met with such success, if by success we mean its ability to predict and explain insight problem performance as reflecting individual differences in working memory capacity and intelligence: Working memory capacity underlie a person's ability to construct, maintain and transform representations of the world. Crucially, the methodology employed tasks 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 a physical world to solve a problem that arises in that world, (first order problem solving), but rather problem solving is removed from the external world, conducted on the basis of representations of the world (second-order problem solving). Second order problem solving proceeds from participants' interpretation and representations of these representations. In other words, the problems that could arise in a physical world, corresponding to physical processes of varying complexity, are presented as second-order abstractions. First-order problem solving is impossible since participants cannot engage or interact with a physical presentation of the problem. Second order problem solving carries with it a representational toll and as a result, individual differences in the ability to maintain and transform mental representations—as gauged in terms of working memory capacity—correlate with problem solving performance. The research methodology thus validates rather than tests the foundational pillars of the dominant research programme.

First-order Problem Solving: Insight Distilled through Action. Let's transpose the socks problem, as described above, from verbal riddle into a physical model of the problem (from second order to first order). Imagine a duffle bag with 40 black socks and 50 brown socks. Our participant reads the problem description, and is invited to determine how many socks she'll have to sample before getting a pair of matching colour. She's told she can dig into the bag and pull a few socks, one at a time, to help her solve the problem. The misleading ratio information in the problem description might not attract her attention as much as it would otherwise were she only presented with the riddle without a physical model of the problem. She might not know how to solve the problem; she starts pulling a few individual socks, not strategically, not with a plan in mind, no proto-solution guiding her action, but simply exploring, interacting with the problem and observing results. The misleading ratio information quickly fails to exert any attraction; rather she's looking at the results of her sampling from the bag. She may pull two black socks from the start, tempted to say that the answer might simply be 'two', but realises that she's been lucky, pulls a third one and fourth one, and the solution dawns on her; the solution is distilled through action and results. The insight, if there is one to experience, takes place when she observes the results of her actions. Pulling socks out of the bag is an epistemic action of sorts (e.g., Kirsh, 2009), each drawn sock providing information and the outcome of a few draws brings the solution into focus. That is, the solution of the problem is observed rather than mentally simulated. No exact plan or arithmetic knowledge determines her behaviour. Interacting with a physical model of the problem offers perceptual information and action possibilities. Problem solving is taken out of the head and enacted in the world: The solution is physically crafted and perceived.

The reasoner, the physical reality of the problem, and the action possibilities offered by the external environment, configure a cognitive ecosystem (Hutchins, 2010). Interactivity assembles, creates and maintains this ecosystem. Cognitive results are produced by this ecosystem (cf. Giere, 2006) and as such interactivity is an ontological substrate (Steffensen, 2017): the process from which new ideas are formed. Cognitive results emerge over time and space reflecting multiscalar tensions. At very short time scales, perception-action loops chart the problem solving trajectory, at slower time scales the reasoner reflects on results, taking stock of the past and formulating hypotheses as to what should be done next. The problem solving trajectory is paved through dynamic changes within the physical configuration of the problem, which in turn creates a shifting topography of action affordances. These actions need not be—and at very short time scales, cannot be—mediated by complex representations of the problem. The physical world is there to experience (we are immersed in the physical world), and actions may reflect the perceptual exploration of the problem. Traditional concerns with working memory capacity make sense only if problem solving is assumed to involve a hefty representational burden, that is if it is primarily a second-order problem solving activity. In contrast, if problem solving proceeds primarily on the basis of actions that modify the physical substrate of the cognitive ecosystem, then changes can in turn focus attention and cue action. This leaves working memory capacity as a marginal predictor of problem solving success. Rather, the solution emerges through changes in the problem configuration enacted and observed by the reasoner. As a process that extends over time and space, problem solving follows a contingent itinerary; it becomes important to record that itinerary if we want to understand how a problem is actually solved.

We recently examined how participants solved a so-called ‘pure’ insight problem (Weisberg, 1995): how to distribute 17 animals in four enclosures such that each enclosure contains an odd number of animals. On the surface, the problem masquerades as a simple arithmetic one; however, no combination of four odd numbers can sum to 17. The challenge then is to abandon this arithmetic interpretation and work on the spatial arrangements of the enclosures in order to exploit set intersections. In a series of experiments (Vallée-Tourangeau, Steffensen, Vallée-Tourangeau, & Sirota, 2016) we observed participants working on a solution for a period of 10 minutes in one of two task environments that differed in the tools available and type of interactivity. Participants in one environment were given an electronic tablet and a stylus with which to sketch a solution. In the first of two experiments, no participant solved the problem, in a second 17% did. With a stylus, participants are encouraged to write whole numbers—as opposed to make individuated marks corresponding to the animals—labouring an impossible arithmetic solution. Equally important, once pens were drawn, often as crosses that created quadrants on the middle of the tablet, pens were rarely re-drawn. Thus the common pen configuration reinforced the misleading arithmetic interpretation, and their static nature suggested that they were rarely if ever the focus of attention (Vallée-Tourangeau, Steffensen, Vallée-Tourangeau, & Makri, 2015). In sum, the tools and actions afforded by this ecosystem were more likely to perpetuate the incorrect interpretation of the problem which reinforced a stale problem solving strategy.

In a second condition, participants were invited to build a solution of the problem with pipe cleaners and 17 animal figurines; they were not given pen or stylus, paper or electronic tablet, with which to sketch a solution. The model building environment configures a very different cognitive ecosystem. For one, participants cannot easily manipulate explicit number symbols, and as a result the quixotic iterative search of which four odd numbers can add to 17 is much less likely; without pen and paper there are no tools that cue basic scholastic schemas. Second, participants must construct pens and their activity initially focuses on the key element of the problem, namely the shape and spatial arrangements of the pens. Participants in both conditions read the same problem description, yet the different tools and action possibilities facilitate very different problem solving strategies (Vallée-Tourangeau et al., 2015). In the model building environment, over 40% of the participants produced a working model of the solution in the allocated 10 minutes with an additional 15% building proto-solutions involving intersecting enclosures. The 17 animals problem is hard to solve, especially with limited time. Building a model of the solution helped participants to abandon an unproductive arithmetic interpretation of problem. However, interactivity weaves a path, and the artefacts provided sometimes cued participants to perform actions that lead to a cul-de-sac. For example, a few built tagliatelle-type nests for the enclosures, presumably to prevent the animals from jumping over. In one of the experiments, the figurines employed were zebra-shaped paper clips, and a few participants took advantage of this affordance and clipped animals onto the pipe cleaning pieces. Building high nests and clipping animals to the perimeters of enclosures created perspectives which ruled out envisaging an overlapping set solution. The point is that a participant's problem solving trajectory is singular and contingent. Because action possibilities depend on previous results, it becomes particularly important to examine detailed video evidence on a case by case basis, in order to understand how each participant manages to build a working model.

We profiled participants in both conditions in terms of their working memory capacity—computational and visuo-spatial span tests courtesy of the Randall Engle lab at Georgia Tech—as well as their thinking dispositions using the short version of an actively open-minded thinking scale (Haran, Ritov, & Mellers, 2013) and the need for cognition scale (Cacioppo, Petty, & Kao, 1984) to gauge their openness to new ideas, willingness to abandon discredited ones, and attitudes towards effortful cognition (such as enjoying challenging puzzles). Since participants were randomly allocated to either the tablet or the model building condition, we expected no difference between conditions in terms of these psychometric dimensions, and indeed there were none. Thus participants who failed to produce a solution to the 17 animals problem had the same working memory capacity and the same thinking dispositions as those in the model building condition. In the model building condition we also compared participants who built a working model of the solution with those who failed: None of the psychometric variables predicted problem solving success. Theoretical concepts traditionally offered to explain problem solving performance in terms of features internal to the reasoner failed to account for any of the variance in our experiment. As Malafouris (2014, p. 148) argues, creativity “is not the kind of psychological process that one could quantify by adapting the usual creativity measurements (e.g., divergent thinking tests and insight questionnaires)”. This is because the generation of new ideas is a process characterised by its dynamic, situated and emergent properties that “defy the psychometric, individualistic, and largely Westernised logic of such measurements, as well as their misleading emphasis on individual genius or talent as the main source of new-idea generation” (p. 148). Rather, to understand how successful problem solving performance comes about, it makes more sense to refocus research onto the cognitive ecosystem within which solutions are enacted and through which weaves a solution-probing path, contingent on interactivity. We must examine the distributed resources of a system configured through the dynamic coupling of reasoner and material environment. Insight is connected, not so much to a new way of looking at a problem, but to a new way a problem can look once its physical appearance has been shaped and reshaped through interactivity. We argue that insight is not about looking at a problem in a new way, it is about interacting with its physical reality and noticing the change in the way it looks.

Yet, problem solving research in psychology proceeds under the aegis of a psychometric model. Thus the psychometric model assumes that problem solving is a mental phenomenon and as such reflects processes that transform mental representations (e.g., representations of the problem, the initial state, the goal state). People vary in cognitive capacities that facilitate the transformations of mental representations: A mind that is better at simulataneously holding and manipulating many elements of a problem representation simultaneously will be more adept at solving problems. The psychometric model is bolstered and emboldened by correlations that evidence a link between generic cognitive capacities and problem-solving performance, whether of the insight or non-insight kind. This assumption is in turn motivated by a tacit commitment to methodological individualism: Thinking and insight are mental phenomena that require explanations in terms of mental operations that occur within an individual, or more specifically within an individual's head.

The psychology of problem solving has been largely indifferent to the development of ideas in philosophy and cognitive science in terms of extended minds, situated and distributed cognition. Yet, beyond the methodological confines of the psychologist's laboratory, it does not require much ethnographic effort to notice that people think with their hands, their body, and a wide range of disparate artefacts. External resources are recruited, configuring extended cognitive systems that scaffold thinking and reasoning. These extended cognitive systems are assembled through an agent's actions. Interaction with the physical environment is a key feature of thinking outside the laboratory. Yet cognitive psychologists exert little systematic effort (or interest) to determine how interactivity may impact problem solving under laboratory conditions, and how the psychometric model fares with tasks designed to allow participants to alter the physical presentations of a problem.

Problem solving is dynamic and distributed, enacted spatio-temporarily. It is an interactive process that engages a wide range of resources, such as artefacts, people, even galaxies (e.g., as gravitational lenses). It is heteroscalar: judgments and choices can reflect picoscale processes for which psychophysics and neuroscience are best positioned to offer explanations, and they can reflect macroscale factors amenable to sociological, historical and philosophical analysis. Both science and art are problem solving activities. These activities trace a path that is deeply contingent, dotted with interim stages, proto-solutions and preliminary models. These interim products are boundary objects that bind but also transform actions and people in enacting the problem solving itinerary.

The psychometric model cannot explain first-order problem solving actions and the resulting problem solving itinerary. To better understand the genesis of insight, of new ideas, of new forms, one should examine carefully, on the basis of detailed case studies, the conditions from which these forms emerge. These conditions are features of the agent-environment ecosystem. It makes no sense to proceed by characterizing the agent and the environment independently at some arbitrary point in the problem solving itinerary. Rather, one should aim to capture the co-constitutive agent-environment transactional forces that create and maintain the ecosystem. In the laboratory this can be achieved only through a detailed qualitative analysis of a participant's action as he or she works within an ecosystem that affords the physical manipulation of the problem. For example, Steffensen et al. (2016) made a detailed analyse of the video recording (over 1200 annotations for a 10-minute session) of a single participant successfully solving the 17 animals problem. During the first two minutes, the participant spent time building enclosures. In the process, she occasionally created overlapping pens which she would promptly disassemble in order to maintain a configuration of 4 separate enclosures. The participant spent four minutes trying to distribute the 17 figurines into these separated pens in her attempts to find a solution. Frustrated with her inability to crack the problem, the participant placed all the animals in a heap in the middle of the work surface and focused her attention on the pens themselves. While fiddling with the shape of one enclosure, she accidentally created an overlap. She began to remove it, but stopped just as she was about to touch one of the pens. Then straightaway, instead of undoing the overlap, she created another two intersections by moving the two remaining pens. With these three overlapping areas, she had achieved a configuration that cued some interesting possibilities for her; possibilities that were not available to her earlier in the session. Accordingly, she now proceeded to distribute the animals to match the odd number constraint.

When did she solve the problem? She solved it when she constructed a working model of the solution. Did she solve it when she produced overlapping sets? We would argue that she did not, but rather sought encouragement from this new arrangement and began systematically working at populating this new enclosure configuration. Her actions in the first 6 minutes of the session appeared to be guided by a plan that was determined by a misleading arithmetic interpretation of the problem. But her actions at the event pivot did not reflect a plan. At the point when she took advantage of an overlap, it was her actions that distilled a plan. That is, a working solution was enacted rather than mentally simulated. Her solution arises out of a contingent path that initially takes her through her failed attempts to distribute her flock into separate pens followed by an accidental overlap that was opportunistically seized and exploited to drive new distribution efforts. The event pivot at the 6-minute mark is an important discontinuity but the significance of the overlap was noticed only at a certain point in the trajectory; earlier accidental overlaps were destroyed. Thus, we can understand her success from a contingent-historical perspective of failures and adjustments. The physical model was constructed into a working solution, but it is incorrect to say that the construction reflected the implementation of a plan (cf. Ingold, 2010).

Creative Problem Solving with Clay

The poverty of the psychometric model of problem solving is further exposed when taken out of the second order problem solving arena from which it was formulated. The situated and distributed character of problem solving in the wild has been clearly illustrated in the work of Lave (1988) and Hutchins (1995). The challenges faced by the psychometric paradigm to explain creative problem solving come sharply into focus as we scale up from research conducted by experimental psychologists in the laboratory, to problem solving in professional, creative domains, such as design, science and the arts. A professional creative agent (qua designer, molecular biologist, or sculptor) may toil for days, months or years on a client's brief, an engineering problem, or a large-scale clay sculptural installation before completing a project. This form of creative problem solving unfolds in time and space, within a network of cultural practices, and often results in a long trail of interim artefacts (such as sketches, models and prototypes). Clearly these agents can be profiled along psychometric dimensions, but the creative arc is complex, shaped by processes operating in different temporal dimensions; it is profoundly and unpredictably contingent.

In the second half of the paper we shift perspective and narrative voice from a nomothetic commentary on the psychometric model of creative problem solving to Paul March's commentary on the creative arc in the production of a large clay sculptural installation entitled *Claustra* (see Figure 1).

Figure 1. Claustra; stoneware 1.8 x 2.0 x 1.8 m, 2015.

This commentary augments and complements the critical analysis offered in the first part of the paper, but also underscores the artist as a situated creative agent, and details the creative, cognitive and cultural ecosystem within which an artist enacts a work of art. This case study offers a mix of ontological and phenomenological reflections and can be summarized in terms of four main observations. First, a short-term analysis of the process of creativity tends towards a description that links an idea (cause) with an effect (art work). A longer term analysis embeds the art-work in a network of interconnecting arcs of influence. By extending the temporal analysis, the case study contrasts creativity as originating with ideas, with creativity as embedded in work-practice. Second, the chronological experience of time can be disrupted. That is, time's arrow can sometimes feel as though it is pointing backwards. If the development of a work of art is seen as a journey, then the journey is not always experienced chronologically. Third, the locus of creativity is not cerebral but is found in the interactive movement of hand and material. Little goes on in the mind in isolation from the environment. Fourth, contrary to a mentalist interpretation, the experience of insight or what is known as a lightbulb moment is often an indication that something new, unusual and interesting has just happened in the world. It therefore seems more appropriate to replace the term 'insight' with 'outsight'[1].

Beyond the Hylomorphic Genesis of Art

An information processing (hylomorphic) approach to artistic creation suggests that a work of art is a material realisation of one or more ideas or internal images (e.g., Boden, 2004). Seen in this way, art has a useful representational role: It makes the internal world of the artist accessible to others. This view further suggests that the internal world of an artist is,

[1] Oxford Dictionary defines outsight as a "Vision or perception of external things; the capacity to see or observe; (the ability to take) an overview." We are suggesting a reformulation of "Outsight" to mean instead "arrive at an understanding or a solution of a complicated problem or situation while observing or manipulating the external world."

in its turn, influenced by his/her experience of the external world. So when looking at the origins of an artwork it is conventional to begin the story with the birth of a creative idea before turning a retrospective gaze on the artist to search for clues as to how her personality became manifest in the artwork. This position seems reasonable. It is consistent with how art is taught in schools. It is underwritten by one of the most influential recent movements within the art world—conceptual art—and it seems to chime with subjective experience. For example, while running a clay workshop for children, March noticed how, from time to time, children as young as seven or eight years old would remain frozen in front of a lump of clay, complaining that they did not know how to start because they did not have any ideas. The children's remarks imply that the idea behind an artwork provides us with intention. Having an idea allows us to pass into action. Without an idea we do not know what we are doing and so we do nothing at all. As Latour (1999) points out, if the activity of the brain is seen as something that happens separately from the activity of the world then a concept such as ‘intention’ becomes necessary in order to explain how brain activity can have an external influence. However, it is our contention that by adding context, by embedding a particular creative act within an ongoing process of artistic creation, the above model of creation based upon linear causation becomes impossible to maintain. Instead a more confusing and messier, systemic pattern emerges. In order to render things more comprehensible we have tidied up the mess a bit by dividing the description into four section. We move also to a first-person account.

Symmetry

An art-work does not normally occur in isolation but is part of a process of ongoing artistic activity. *Claustra* was preceded by a series of sculptures (*Substantia Innominata,* 2014; see Figure 2). Each sculpture was both highly structured and yet perceptually indeterminate - giving the impression that there was something to recognise without the sculpture ever settling into an acceptable thing in the eye of the beholder.

While making these pieces, symmetry emerged as a way of giving structure to otherwise indeterminable shapes. In addition, I found I could extend the uncertainty about my relationship with these emerging forms and their relationship with each other by creating each half, side by side, only bringing them together at the end. In this way, I also noticed that the symmetrical halves had a very different relationship with each other as separate pieces compared with when they were unified. In particular, as separate things, they created a space

Figure 2. *Substantia Innominata,* III stoneware 0.3 x 0.4 x 0.2 m, 2014.

between them that became a quasi-thing in itself (see Casati & Varzi, 1994, for a description of the object-status of holes). As the series progressed, I found it increasingly difficult to bring the pieces together. They seemed to prefer to be separate. Perhaps this resistance marks the beginnings of *Claustra*.

Perceiving the space between the symmetrical parts as a quasi-thing was a discovery that I made while observing the changing juxtaposition of the parts in my hands. It was not an idea or a concept that I wished to make manifest. It manifested itself to me. The change here is not ideational, it emerges from the repetitive rhythm of action and reaction. Seen thus, the separated symmetry of Claustra is not conceptually conceived but ontogenetically continuous. - an example of, what Marion Milner (1950) calls “contemplative action”. When I experience the nascent *Claustra* as a change in work-practice rather than as a creative idea I become a participant-observer in an ongoing reconfiguration of my surroundings. During the act of making it feels like I am part of an evolving collaboration but after the event it becomes more of a struggle to describe things in these terms. In the absence of clay as a dynamic, material substrate, the memory of creative change becomes isolated and abstracted from the making process, appearing instead to be the outcome of an antecedent concept or idea.

Whereas the sculpting process undoubtedly involves considerable mental activity it does not follow that the locus of creativity is cerebral. The above description suggests not only that the creativity has an extracorporeal spatial coordinate but that its locus goes beyond the dimension of space. It exists in an experiential dimension in which time, space and creative change are reciprocally co-constructed. From a subjective point of view, space is not a pre-existing container, vacant until I fill it with a sculpture, subjective space is created along with the sculpture.

Haytor, the Vogelherd Lion (and the Jura)

The most conspicuous geological feature of Dartmoor (Devon UK) is its granite outcrops known as Tors. Sculpted by the erosion of wind and rain they take up extraordinary and beautiful forms. Haytor is a particular fine example (see Figure 3).

Figure 3. Haytor, Dartmoor, United Kingdom.

One day, while sculpting there was something in the shape of the clay that reminded me

Figure 4. View of the Jura from the artist's workshop window.

of Haytor. Or rather, the clay brought forth a memory of Haytor at the same time as a memory of Haytor was influencing the emerging clay form. Whether or not these memories were ideational is an important question but beyond the scope of this paper. But whatever their subjective imaginal status, memories are not static records of the past like photos in an album. As Høffding and Martigny (2016) describe, to bring to mind something from the past is to have a new, unique experience in the present. From the window of my workshop in Geneva I can see the Jura Mountains (see Figure 4) but I cannot see Haytor so I brought up an image of the Tor on my computer. I now had an image of Haytor in front of me with the Jura beyond.

Named after the cave in the Swabian Jura (Southwest Germany) in which it was found, the Vogelherd Lion is a small, Palaeolithic sculpture carved from mammoth ivory. On the windowsill of my workshop in-between the image of Haytor and the Jura Mountains stood a replica of the Vogelherd Lion (see Figure 5). I had ordered it from Ebay some months earlier for similar reasons that I had brought up the photo of Haytor on my screen - something in the work I had been doing at the time prompted a memory of it. Until the two (or three including the Jura Mountains in the background) were brought together within my gaze, I had not considered joining them in a project. Now in an "aha!" moment I saw that Haytor and the lion had similar forms and yet, by transposing one upon the other something new could emerge. While this appears to be an example of insight, given that it took place out there, in plain view it is perhaps better described it as “outsight”.

The Jali Screen

In 2013 I made a large ceramic sculpture called *Extended Phenotype 4* (which incidentally also played with the concept of bilateral symmetry; see Figure 6, left panel). To lend support during construction, I created an internal clay “scaffolding” which was hidden

Figure 5. The Vogelherd Lion (left panel) and the replica sitting on the artist's windowsill (right panel).

inside once the finished piece was fired and reconstructed (see Figure 6, right panel). The scaffolding was serious, efficient and workmanlike but it also had a touchingly naive aspect to it. The interplay between these two, conflicting impressions gave it both force and appeal and I was sorry to have to hide it from view.

I think that the feeling of sorrow meant that, as the Claustra project began to take shape, it did so with the tacit acceptance that the scaffolding of Phenotype 4 would be rehabilitated and rendered visible to support the “cut” walls of Claustra. As such, I hoped that the juxtaposition of rock-like surface and naive-but-functional scaffolding would create a bizarre

Figure 6. Extended Phenotype (extant) stoneware, 3.5 x 1.0 x 1.0m, 2013 (left panel); view of the inside of a section of Extended Phenotype 4 (right panel).

yet coherent tension. But in reality, I had no idea what the two different formations would make of each other. I therefore made a small maquette of the entire structure to investigate the specific interplay between scaffolding and rock-face but also as a way of thinking about the overall proportions and structure of the two pieces and the space between them (see Figure 7).

The function of the maquette was not to make manifest a pre-existing internal image of an artwork. Nor was it intended as a miniature version of the final work any more than a map is a version of a particular territory. Like a map, the maquette helped me to orient further exploration. It was a guide to the whereabouts of some significant landmarks that left the terrain in-between largely unknown. Creating the maquette was an important transformative stage. It created certain constraints which, while not determinant, served to provide some structural stability. In so doing the maquette paradoxically provided me with the freedom to take risks and thus make discoveries that would have been impossible in a completely unconstrained environment.

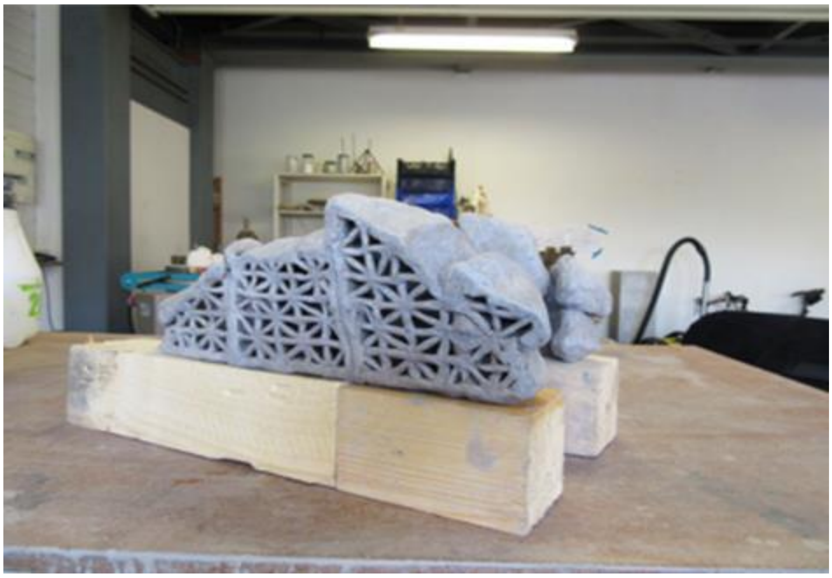

Figure 7. Maquette of *Claustra*

With regard to exposing the relationship between scaffolding and rock-face, the maquette suggested a certain antagonism between the two which I can only describe in the following metaphorically animistic terms. “The well-executed stone surface took exception to the rudimentary and primitive construction of the scaffolding.” I was surprised because it was exactly this juxtaposition that had appealed to me when looking at the relationship between the support system for *Extended Phenotype 4* and the organic/mineral external body of the piece. Responding to my own surprise, I began the construction of a full-size model of two sections of the sculpture (see Figure 8).

I constructed the matrix of the lower section in a reasonably precise manner before returning to a more naive but functional construction for the upper section. Comparing the two I found that, unlike the naive version, the precisely made matrix suggested a rhythm, mystery and strange formality that lived in happy yet contradictory coexistence with the rock surface. I therefore began constructing the final, full-scale version in this careful and precise way. As the work proceeded, it brought to mind the perforated ornamental screens or ‘Jali` that are found in Indian and Islamic (Mashrabiya) architecture. As “latticework” replaced “scaffolding” as a description of my perception of the structure, I began to experience it creating similar paradoxical separations that one finds in Mosques, cloisters or in the confession box (see Figure 9).

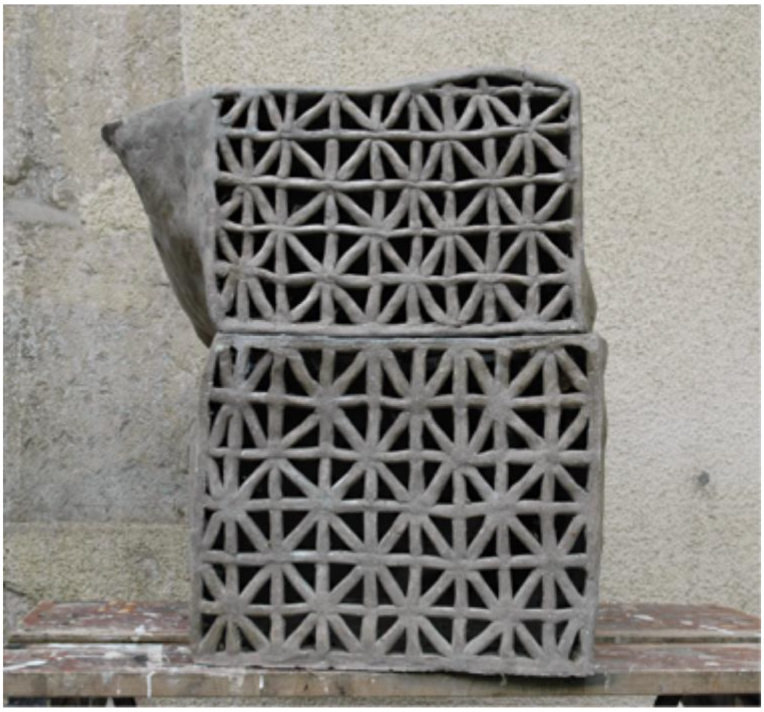

Figure 8. Two test sections for *Claustra*.

There was no prior intention on my part to refer to Islamic or Indian architecture or to the confession box. The association between material structure and religious conceptualisation developed only as I manipulated the sculpture. Nevertheless, when an exciting act of creativity like this takes place between my hands I am tempted to take the credit for it. But this act of self-affirmation requires the development of a hylomorphic attitude in which agency becomes a property of the person rather than the system. In social psychology this is referred to as the “self-serving bias” (see for example, Mezulis et al. 2004)

Figure 9. Example of Mashrabiya from the Alijaferia Palace, Zaragotha, Spain (left panel); view of the lattice work

Rotating the Cut

Quite early in the development of the project, I remembered seeing an installation many years before by Damien Hirst, *Prodigal Son (Divided,* 1994). It presents the body of a dead calf, cut along its longitudinal axis, each half placed in a tank of formaldehyde with the two tanks positioned opposite each other. I cannot now remember whether it had been possible to walk in the space between the two tanks or whether I had merely thought that it would have been good if it had been possible. Either way, my recollection of *Prodigal Son* came with the conviction that my experience (real or invented) of being between the two tanks must have been instrumental in the genesis of *Claustra*. But this assumption flew in the face of the order of events: it was the ongoing work on C*laustra* that brought *Prodigal Son* to mind, not visa-versa. I have written elsewhere (March, 2017) about this paradoxical phenomenon whereby elements that are felt to have inspired a work are not present at its conception, but emerge instead during the course of its development. It is as though the emerging work brings its own antecedents into being. Normally what then happens is that I briefly re-experience the genesis of the work, this time with its origins in their proper, chronological order. Despite this sense of history re-writing itself, I suspect that the re-ordering of experience has less to do with putting things in their proper order and more to do with the influence of a pervasive ontological view predicated upon cause and effect. Within this view, effect never precedes cause. But Material Engagement Theory offers an alternative description: Malafouris (2013) proposes that with Enactive Signification the concept is conceived of only at the moment of materialisation; the signifier and the signified arise simultaneously.

Hirst positions the two cut sides of *Prodigal Son* facing each other. When the installation came to mind in the context of *Claustra,* the thought included the implicit assumption that *Claustra* too would be oriented in the same fashion. However, in order to build the rock sides of *Claustra in a* symmetrical manner, it was necessary to position those two sides facing each other so that I could see and have access to both simultaneously. This arrangement encouraged me to work in an unexpected way. After having initially built up the rough shape of each side separately (in series) I began to work on both sides simultaneously (in parallel). Standing between the two sides and facing along the axis of symmetry I would place each hand on equivalent parts of the two rock faces and sculpt use mirrored gestures, often with my eyes shut, in order to better feel the symmetry through my fingers.

Symmetry was not something that was imposed. It developed in the following way. One side (A) might look and feel more appealing than the other (B). In response, I would concentrate on (B), bringing it closer to the form of (A). But during its transformation, (B) might take on a form that went beyond that of (A). In response, my focus would return to (A) in an attempt to steer it towards (B) and so on. In this way, the two sides of the installation nudged each other backwards and forwards towards their final composition. The two halves served as dynamic references for the other. As such, my role was not one of instigator or initiator. It felt more like the role of an umpire in a tennis match. I was part of a decision making body that included the ever changing morphology of the clay. As with the lump of clay I mentioned earlier that referred to Haytor, the morphology of *Claustra* makes references to other things. But this is not the same as representing other things. The creative system that I am calling *Claustra*, and which included the actions of my body, brought itself about. It is a re-presentation neither of an existing structure nor of a pre-conception.

Once the two halves were complete I left them with the rock surfaces facing each other while they dried. I am not sure at what point this orientation came to be also that of the final installation in the exhibition. The two structures had grown and developed in this position over the previous months and I had spent much of that time in between the two with my hands upon both. This combination made the thought of rotating the two halves to bring them into line with *Prodigal Son* difficult to entertain. Once the piece was fired and I could physically compare the two options, I was left in no doubt that the exhibition positioning should follow the construction orientation.

Conclusions

It might be argued that our suggestion to replace “insight” with “outsight” as a description of a moment of problem resolution or of creative discovery does nothing more than change the direction of a linear model of causation from one that formerly had mental activity determining external activity to the reverse. We hope that it is clear both from the experimental material we have presented as well as the case study that this was not at all our intention. Rather, we have put forward a systemic, interactional model in which the question of the origin of causation becomes irrelevant. By concentrating on the process of creative problem-solving in relation to the manipulation of material things we do not wish to minimise the importance of cerebral activity. We accept that there is much to learn from the development of cognitive and neurological models of brain function. Rather, by redefining “outsight” and promoting it as an alternative to “insight” we wish to draw attention to the fact that real-world problem solving can never be properly understood by divorcing it from the real world within which it not only occurs but also has a hand in creating and influencing.

To achieve this, we have taken a two-pronged approach. First, by reconfiguring the traditional insight problem solving research procedure with physical models of the problem, we illustrate how eagerly participants embrace the opportunity to use artefacts to resolve problems successfully that were beyond the scope of their internal resources alone. We are not claiming that humans have no capacity for mental simulation nor that it cannot be used in a problem solving task. Clearly second order problem solving, based on abstract representations of the world, is not only possible but is routinely encountered in scholastic environments. In addition, much psychometric research in occupational psychology profiles people's ability to solve problems this way, with important employability implications. Instead, we argue, along with Clarke (2010), that participants engage in isolated mental activity only if they are prevented from being in real-time relation with the world. Of course one might argue that, by changing, for example, the socks riddle into a physical model we are simply removing a tricky problem and replacing it with a simple sorting task. But that which is unknown remains the same, and rather than simulating different permutations and deriving the consequences of misleading odds information, the problem solver simply gets to work, with the world, to arrive at a satisfying answer. It is the coupling with the world that enhances creative problem solving. We are offering an alternative to the mentalist position that creativity and intelligence are the product of a disembodied computational device which is best investigated using disembodied second-order problem solving tests.

Second, our aim in presenting the case study was to show the extent to which creative decision making is embedded in the process of material change. The focus on symmetry becomes normalised by considering it in its historical context. In addition, the recursive relationship between the process of finding symmetry and of the final morphology undermines explanations of the creative process that describe art as serving a representative role for something that lies beyond the system of production.

Likewise, the detailed descriptions of the transposition of Haytor and the Vogelherd Lion and of the evolution of scaffolding into latticework both undermine explanations of creation that are couched in terms of insight. It is our contention that once the decision-making process is considered in its physical and historical context, it is difficult to formulate how this example of artistic practice could have proceeded in the absence of a reciprocal relationship with material.

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