Interpretation as Driver for Psychological Creativity

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ABSTRACT

This paper describes some acts of psychological creativity as phenomena arising from changes to a situation, brought about through interpretation. It presents a way of representing a situation as a schema of concepts made up from perceptual dimensions. It shows the utility of concepts as being changed by the situation within which they are used. An example of this is described, in which the information within a concept is unchanged yet its use becomes different through salience weighting. A computational implemented example is presented as a generate-and-interpret model that produces country growth indicators and then interprets them and repeats this process. The situation, and the space of possible designs, is changed through the act of interpretation. It is suggested that interpretation can be a driver for changing situations – something that looks like P-creativity to an outside observer.

Keywords
Situated cognition, interpretation, situated design, P-creativity

ACM Classification Keywords
J.4 Social and Behavoral Sciences: Psychology

General Terms
Design, Human Factors.

INTRODUCTION
When a designer has an idea that is both new and useful, an act of psychological creativity (P-creativity) has occurred [2]. This work suggests that an act of P-creativity can be described as a change of a designer's *situation* [4]. Consider the way that a designer looks at work they have just created and sees previously unobserved features [6]. For example, an architect suddenly decides that their recently sketched floor plan is 'not square enough'; an artist looks at their work and concludes that 'we could try distorting this more'; a musician suddenly decides that 'we could try syncopation here'. This kind of change to the design trajectory can be observed in designers [9]. This paper suggests one way of reproducing this class of

phenomena, that constitutes an act of P-creativity, is through a change of the designer's situation brought about through interpretation.

Situated design [4,7] holds that design activity occurs within a situation, the current 'world view' of the designer, that can be considered as a network of concepts. As design activity progresses, this situation changes. This work frames the question: how does the situation of a designer change? It provides examples to support the claim that failed expectations during interpretation can be a driver for this change of situation, from which P-creativity can be observed.

In this work we describe a way of representing situations as well as how situations can become changed through interpretation. An example is provided in a model that uses a method of *generate-and-interpret*.

REPRESENTING SITUATIONS IN CONCEPTUAL SPACE
When we say that a designer 'knows about A' it can be considered the equivalent of saying that a designer 'holds a concept about A that has its basis in abstractions from the world' [1]. Concepts can be represented geometrically through the creation of conceptual spaces [3].
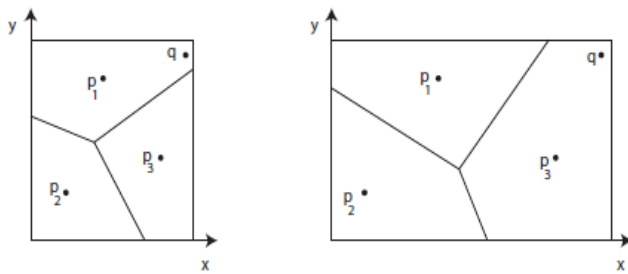
In this work, conceptual spaces are extended to represent situations. A situation brings a number of concepts together. Some concepts held by an agent are inside the current situation and some are not. Those concepts within the situation are not discrete units of knowledge, but rather are taken together as a 'situation' that alters all of the concepts – the whole in each of the parts. An example of how to achieve this computationally is presented, using salience weighting as an example.

Salience Weighting within Conceptual Space
Gärdenfors [3] describes that conceptual spaces can be distorted by dimensional scaling. Any operations carried out within this space, such as determining similarity through distance [5] are unchanged in process, but the result is different because they take place within an altered space.

One way to achieve this is formalized, in which the situation changes the use of each concept by determining the salient dimensions within the situation, and then scaling the conceptual space accordingly. This is done by extending the notion of salience weighting to introduce the

effects of situation, Figure 1. Instead of changing concepts due to the situation, the space within which concepts are located is changed. Any future operations carried out within the space are now different.

Figure 1 Voronoi tessellation of a space with three concepts, p_1, p_2 and p_3, before and after salience weighting, resulting in different classification of the external object q (after [3])

Changes to the Situation in Design Activity

The situation of a designer changes when it no longer works. The claim in this paper is that this can occur during interpretation, when the expectations held by a designer are unable to explain perceptions from the world. Examples are given of the way that this can lead to a change of the designer's situation.
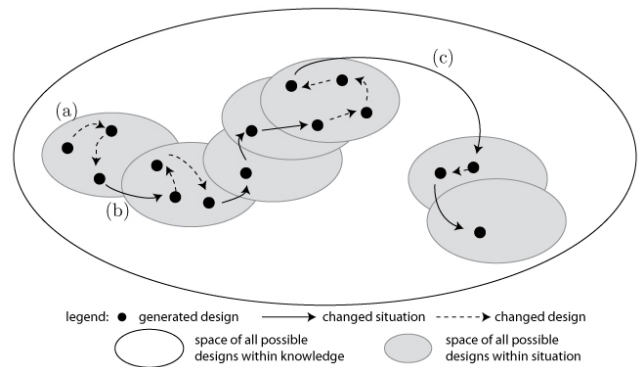
IMPLEMENTING SITUATIONAL CHANGE

A model was implemented to demonstrate the way that a change of situation in this way can look like P-creativity to an external observer. It demonstrates situational salience weighting and the way that it alters the movement between different situations.

In one example, an agent is engaged in a cycle of generate-and-interpret, generating within a cycle of synthesis that has no fitness function – it continues this loop indefinitely. When interpretation occurs, there is an expectation to find the concepts that were held prior to generating. Sometimes these expectations will be met and at other times they will not. If the data from perception is distant from the expected concepts then it cannot be interpreted within the situation, leading to a change of situation.

The first implementation is in the domain of interpreting floor plans and is implemented using two linked self organizing maps. It shows the way that an agent moves around within its own knowledge, Figure 2. Whilst the situation is unchanged the agent is exploring within a limited space of possible designs. In interpretation the situation can change, leading to a new space of possible designs that may or may not overlap the previous space.

A second implementation demonstrates the way that the situation changes the use of a concept. The same concept, in two different situations, when considering the same data, results in two different interpretations due to salience weighting.

Figure 2 Generated designs and spaces of possible designs within changing situations in the model: (a) new generations within the same situation; (b) movement to an overlapping space of possible designs; and (c) movement to an entirely new space of possible designs

DISCUSSION

The claim made in this paper is that a change of situation appears to be like P-creativity to an external observer and that interpretation can trigger this change of situation. Two aspects of this have been demonstrated through computational implementation: (i) a generate-and-interpret model to demonstrate the way that situations can change; and (ii) the way that situations can change the use of concepts.

The work produces a link between the grounded experiences of an agent and the way in which it navigates its own knowledge during a task.

REFERENCES

1. Barsalou, L.W. Abstraction as dynamic interpretation in perceptual symbol systems. In L. Gershkoff-Stowe and D. Rakison (eds), *Building Object Categories. Carnegie Symposium Series*, Erlbaum, NJ (2005), 389-431

2. Boden, M.A. *The Creative Mind: Myths and Mechanisms*. Weidenfeld & Nicholson, London (1990)

3. Gärdenfors, P. *Conceptual Spaces: The Geometry of Thought*. MIT Press, Cambridge, MA (2000)

4. Gero, J.S. Situated design computing: Principles, in B.H.V. Topping (ed). *Civil Engineering Computations: Tools and Techniques*. Stirlingshire (2006), 25-35

5. Nosofsky, R.M. Attention, similarity, and the identification-categorization relationship. *Journal of Experimental Psychology: General* 15 (1986), 39-57.

6. Schön, D.A. *The Reflective Practitioner: How Professionals Think in Action*, Basic Books, NY, (1983)

7. Smith, G. and Gero, J.S. What does an agent mean by being "situated"? *Design Studies* 26 (2005), 535-5

8. Suwa, M., Gero, J.S. and Purcell, T. Unexpected discoveries and S-inventions of design requirements: Important vehicles for a design process. Design Studies 21(6) (2000), 539-567