Conceptual Blending and the Quest for the Holy Creative Process

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Abstract. In this paper, we discuss the role of divergence and convergence in creative processes, and argue about the need to consider them in Computational Creativity research. Furthermore, we give an overview of Conceptual Blending theory, of Fauconnier and Turner (98), as being a promising framework for implementing convergence methods within creativity programs. We present and discuss some current research in the area and suggest next directions.

1. Introduction

While the discussion around the phenomenon of Creativity runs about fundamental issues like clarification of concepts, evaluation, psychological factors or philosophical questions, the quest for Creativity in AI has begun, raising its unavoidable subjects such as knowledge representation, search methods, domain modelling, etc. In this paper, we propose the relatively recent theory of Conceptual Blending (CB), from Gilles Fauconnier and Mark Turner (98) as a valuable research theme around the subject of modelling Creativity, from the point of view of the process.

We start by considering the divergence/convergence characteristics of the creative process as an argument for the need of divergent methods that, at some point, are able to detect a convergent solution as a way of goal accomplishment. Although this may seem the description of search methods in general, it is clear that we may deal with wider amplitudes of divergence in tasks that demand higher creativity. These tasks don't necessarily have to have a particular form or be of a specific kind. However, the quest for a previously unseen and *correct* solution is surely expected. A solution that *traditional* methods don't seem to find.

We think that some qualitative jump must be made in AI such that classical methods become more able to diverge or at least to combine with other processes, such as CB, in order to enter the realms of Creativity.

2. Creative Processes

When searching for the words "creative process", we often find more or less esoteric views on a very common intelligence feature, that of creativity. Apart from the particularities of a given situation involving creativity, we think the underlying processes lie essentially in the general cognitive foundations. Ultimately, we could see any cognitive process as creative w.r.t. its output, once it can be considered a creation (a perception, a concept, an idea) that wasn't there before and has some reason to exist, i.e., it fulfils the demands of novelty and usefulness. To escape from this extreme, we must point out that the *creative tag* is normally applied to situations that escape the usual, convergent, expectable judgement, yet satisfying the subsumed goal. In other words, the process has diverged in some point to unexpected ground in such a way that it doesn't seem purely casual or uninteresting. Several researchers have argued evidence for divergence in the creative process: Guilford's "Divergent Thought" (67) or Koestler's (64) "Bisociation", among others. This drives us to the thought that a creative process should allow some degree of divergence, i.e., tendency to escape from the common, biased solution. Yet, one can only imagine this process as being able to solve some particular goal, however ill defined this goal may be. In fact, divergence seems a natural attitude of thought, being the big challenge to make sense of it, to find value in the unexpected. In other words, it must converge to the objective, sometimes appearing suddenly in the form of an *insight* or *eureka* moment. Paradoxically it may seem, divergence and convergence come together as two opposite attractor points that drive the creative process.

Being intelligence and creativity so closely linked, the concern about this phenomenon in AI research is unarguably worthwhile to invest. Developing and finding processes that are able to create farther than the *conventional* methods should be its primary goal. AI proposes several kinds of processes to solve problems, and there have been some exploration around the creative abilities of each one (e.g., *genetic art*, some experiments with neural networks and music, use of production rules to create architectural designs, use of case-based reasoning to design artefacts, etc.). In a way, this demonstrates that common processes can be creative up to some point. Yet, it is also clear that this is normally what Boden (90) calls *exploratory (e)* creativity: the solutions are found within a pre-defined and clearly bounded search space, i.e., the program follows a normally strict set of rules which bring some degree of predictability but enhance the potential for usefulness and value. On the other side, *transformational (t)* creativity, that of unexpected and highly revolutionary new ideas, is hardly achieved. At this level, issues like evaluation are very difficult to measure. The difference between these two kinds of creativity isn't totally clear, but from a divergent/convergent process perspective, we could say that *t* and *e* are different degrees of the same process[1]. This goes a lot in agreement with those that argue that *t*-creativity is *e*-creativity at the meta-level (Wiggins, 2001).

The question here, regarding an AI research point of view, is about the approaches that we should adopt in order to get our programs *t*-creative instead of *e*-creative or, in other words, how can we allow them to diverge (and then converge) more than we ourselves can predict or purposely encode?

Apart from purely random processes (that become unsurprising once perceived as such), it is very hard to make a machine do what we don't know we want it to do, i.e., be divergent. And this would possibly be the *easiest* part in opposition to that of figuring out what is a correct or incorrect idea or solution to a problem, i.e., convergence. Unless the machine gains its own free will and self-consciousness, whatever this might mean, it is a gigantic task to do so, particularly because it tends to be closed within itself, in its search space within a strict knowledge domain. Surpassing this barrier should be a primary goal in the quest for computational creativity processes. Obviously, this demands the capacity of abstracting to meta-levels, of being able to do meta-level reasoning (from the level of "search in a

[1] An interesting formalization of e and t creativity can be found in (Wiggins, 2001).

domain" to "search in a domain of domains"), such as argued by many (Boden, 90; Wiggins, 2001 and others).

It seems clear, though, that one possible trend of research should be that of extending established AI techniques with abilities of divergence/convergence. In this paper, we propose Conceptual Blending (Fauconnier and Turner, 98) as a starting point for this quest.

3. Conceptual Blending

In recent years, Gilles Fauconnier and Mark Turner have sought for a framework for explaining/interpreting cognitive-linguistic phenomena such as analogy, metaphor, metonymy or counterfactual reasoning. They arrived to a theory of concept integration, named Conceptual Blending,

To explain it in some detail, we must introduce the concept of Mental Space. According to (Fauconnier and Turner, 98), Mental Spaces are partial structures that proliferate when we think and talk, allowing a fine-grained partitioning of our discourse and knowledge structures. As we talk or think, our reasoning focus flows from space to space, transporting and mapping concepts according to points of view, presuppositions, beliefs, changes of mood or tense, analogical counterfactuals and so on, each giving birth to a different mental space.

Blending is generally described as involving two input mental spaces that, according to a given structure mapping, will generate a third one, called Blend. This new domain will maintain partial structure from the input domains and add emergent structure of its own.

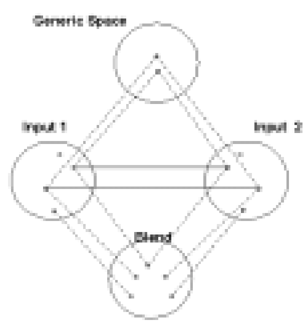

Figure 1 – Conceptual Blending Theory

As can be seen in figure 1, a generic space is also considered. This can be seen as having a unification role, such that concepts mapped onto each other are considered as belonging to the same, generic, concept.

Some examples of blends are: the title of this paper, a blend of the "the quest for the holy grail" and "research towards creative processes"; evolutionary computation, a blend of “natural evolution theories” and “problem solving in computation”; swatch, blend of “swiss” and “watch”; mussorgsky’s “pictures of an exhibition” and many others. As we can see, the presence of Metaphor is a constant. For a discussion on Metaphor and Blending, read (Grady et al, 99).

The Blend has emergent structure that is not provided by the inputs. This happens in three (unrelated) ways (Fauconnier, 97):

1. Composition - Taken together, the projections from the inputs make new relations become available that did not exist in the separate inputs
2. Completion - Knowledge of background frames, cognitive and cultural models, allows the composite structure projected into the blend from the inputs to be viewed as part of a larger self-contained structure in the blend. The pattern in the blend triggered by the inherited structure is "completed" into the larger, emergent structure.
3. Elaboration - The structure in the blend can then be elaborated. This is "running the blend". It consists of cognitive work performed within the blend, according to its own emergent logic.

From the point of view of AI and computation, we can see this process as either generative or analytic: generative, if, for instance, we give two input domains and expect it to integrate them in a new concept, a blend; analytic, if we apply CB for interpreting new concepts in the light of bisociation of domains, i.e., its input spaces. We imagine a *blending* generative module for creating new cases in a CBR system, new individuals in a GA system or new rules in a production system. One can argue that these already have their *blending* procedures, which is true up to the point that jumps to different domains are expected. We also picture a *blending* analytic module as an evaluation procedure for artistic creativity programs (as a way to attribute meaning to the produced artefacts) or as interpreter support for scientific creativity programs. Although these ideas may seem distant and utopic, CB seems a fertile motivation of research that may bring a step forward in computational creativity.

Now analysing the role of CB as a convergent process,, it is clear that integration is the convergence of two (or more) distinct input domains into one, unified, blend. This could be the needed glue for when a divergent process is going on. In our idealized creativity machine, this divergent process could be based on any of the classic AI paradigms, such as CBR or GA’s. In fact, we believe human divergence in creativity is a normal process that varies according to psychological factors, being the convergence moment, when pieces are put together, the hardest part to model in AI because it involves the ability to find (or even assign) similarity and coherence where it is not expected to. This is where we believe CB can be of great contribution.

To give an example to support this claim, let’s imagine a CBR program that has the capacity of generating new cases by combining two distinct case-bases from two different domains. This could happen when it didn’t find a good solution for a given problem and, in this case, it would just go out and search in an apparently unrelated knowledge space. Unless with extreme luck, the resulting cases could only be interpreted in the light of an integration of both domains in question. We are aware this framework raises more questions that it answers, but that's also a motivation for our research.

4. Blending and Computation

AI research on Conceptual Blending is still in its first baby steps, but has already some interesting works to mention. The first to propose a computational blending model were Veale and O'Donoghue (Veale, 2000), who made an extension on Sapper, Veale's metaphor interpretation framework, to comply with CB theory. In this work, the authors argue the applicability of Sapper in relation to CB and suggest a framework, although, in our opinion, not exploring Blending issues in much detail or facing the blend as an independent new domain (as opposition to a domain embedded in a Sapper metaphor interpretation), as argued by the CB theory itself.

Joseph Goguen (99) brought a first formalization of CB according to algebraic semiotics, a step forward in the clarification of the theory. In their approach to Metaphor Reasoning and Mapping Consistency, Leite and Pereira (2000) brought important formal material to blending systematisation. Following this line of research, Pereira and Cardoso (2001) then presented a formalization of the Blender architecture, a simple blending engine.

In near future, we intend to bring an analysis of the formalizations of (Goguen, 99) and (Pereira and Cardoso, 2001). In fact, it is general agreement that CB is very complex and unclear to systematize and it is our next major task to bring a formalization of the whole theory, possibly an extension of the one presented in (Pereira and Cardoso, 2001).

We think formalization and systematisation is the first step to accomplish in the task of bringing Conceptual Blending to computation. As we just said, this is a difficult goal, mainly because the complete CB framework seems extremely abstract and generic. To avoid this problem, Fauconnier and Turner bring a big amount of demonstrative examples, yet it is still very difficult to apprehend a particular Blending algorithm from these. On the contrary, it seems that the correct approach is to consider different algorithms or, at least, several kinds of mapping functions, criteria for applying optimality constraints, unifying frames or mental space representations.

While Conceptual Blending is still a live research area, further developments on its components are expectable, as are discussions around it. An example of such healthy argument is that of Gibbs (2000), which points out some criticisms to CB theory, then replied by Seana Coulson and Todd Oakley (2000).

Conclusions

In this paper, we argued that creative processes must take into account the divergence/convergence characteristics of creativity. It is clear that traditional AI methods are able to diverge and to converge, but normally within a very narrow space, this is naturally because they are tailored to a given task. In extreme, unpredicted situations, these systems tend to fail and we think that, at this moment in AI research life, it's time to deal with a fundamental intelligence component, that of creativity.

We propose that a solution is to widen normal computation methods by enabling them to make cross-domain jumps. This can theoretically be accomplished through Conceptual Blending.

We brought an overview of Conceptual Blending and discussed some issues related to its applicability to AI research of Creativity. We argue that its research in AI must first comply with a systematisation and clarification of the theory and then exploration of all its creative richness.

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