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Thinking Like A Child: The Role of Surface Similarities in Stimulating Creativity

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Abstract

An oft-touted *mantra* for creativity is: *think like a child.* We focus on one particular aspect of child-like thinking here, namely surface similarities. Developmental psychology has convincingly demonstrated, time and again, that younger children use surface similarities for categorization and related tasks; only as they grow older they start to consider functional and structural similarities. We consider examples of puzzles, research on creative problem solving, and two of our recent empirical studies to demonstrate how surface similarities can stimulate creative thinking. We examine the implications of this approach for designing creativity-support systems.

Introduction: Thinking like a child

In popular psychology, an oft-touted *mantra* for increasing creativity is: *think like a child* (Corner 2010, Ewedemi 2011, Greenwood 2009, Lehrer 2010). There is also empirical research demonstrating the effectiveness of this technique (Zabelina and Robinson 2010). We examine here one particular aspect of child-like thinking, namely the focus on surface similarities. There are other aspects of thinking like a child, such as functional fluidity and pretense play, which we will not consider here.

There is a large body of existing research showing that younger children tend to focus on perceptual or surface-level (for example, shape or color) similarities for categorization or for giving meaning to new words, and it is only as they get older they start to use functional, structural or other semantic similarities (Gentner 1988; Gentner and Ratterman 1991, Gottfried 1997; Imai, Gentner & Uchida 1994; Namy & Gentner 2002; Pierce & Gholson 1994; Siltanen 1989). There seems to be a general agreement on this, and the researchers have emphasized, time and again, how it is the functional and structural similarities that are useful for reasoning and categorization, and surface similarities are often thought to be distracting (Faries & Sclossberg 1994). So we will not belabor this point here.

Our aim in this paper is to demonstrate that, at least for creativity, these structural and functional similarities form a severe handicap, and one needs to find ways to suppress them. We will make this argument in three ways: a) by discussing some examples of creativity puzzles, b) by reviewing research on creative problem solving, and c) by presenting two of our recent empirical studies that show how surface similarities can help stimulate creative thinking. Finally, we will conclude by arguing that this focus on surface similarities provides a concrete manifestation of *think-like-a-child* adage, for it basically urges one to think like the younger children of the similarity and categorization experiments. We will also suggest some future research directions based on this approach.

Some examples of creativity puzzles

Consider the problem shown in Fig. 1.

8809 = 6	5555 = 0	7111 = 0
8193 = 3	2172 = 0	8096 = 5
6666= 4	1012 = 1	1111 = 0
7777 = 0	3213 = 0	9999 = 4
7662 = 2	7756 = 1	9313 = 1
6855 = 3	0000 = 4	9881 = 5
2222 = 0	5531 = 0	3333 = 0

2581 = ??

Figure 1: A creativity puzzle

Unless you have already seen it before, it may take you quite a while to figure it out. One answer is 2, which is based on noticing that the number listed against each of the four-digit numbers is the number of circles (closed loops) in the four digits. In fact, the puzzle is usually accompanied by the following text:

> This problem can be solved by pre-school children in five to ten minutes, by programmers in an hour, and by people with higher education… well check it yourself![1]

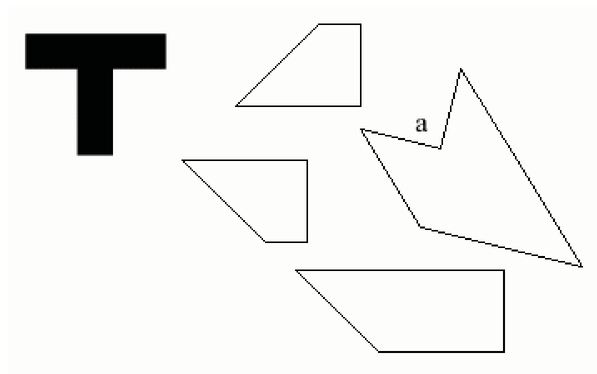
This provides a very strong hint, for you have to rule out complicated mathematical relationships, and have to limit your search for operations familiar to a preschooler. But still many people find it difficult to ignore the many semantic and structural properties of the numbers, and the key to solving the puzzle is to think simpler; or to quote Wittgenstein, "Don't think, but look!"

Consider another example taken from the Mensa genius quiz book: If a jet has a value of 1, and a plane has a value of 2, what is the value of a Concorde? (Grosswirth and Salny 1981, p. 97.) Here again, one's knowledge and semantic associations start to mislead. One correct answer is 3: jet has one vowel, plane two, and Concorde three. There are many such examples, and one of the techniques for solving such problems is to deliberately avoid thinking about the problem in terms of semantic structures or familiar functions.

We should emphasize here that for most people it is very difficult to ignore the conceptual associations we have acquired in our lifetimes, and hence it is actually quite difficult to solve these 'simple' puzzles. This is perhaps best demonstrated by Suzuki and Hiraki's study (1997), where they asked the participants to solve the T-puzzle. This puzzle has four simple shapes, and the objective is to arrange them in the shape of the letter T (Fig. 2). They recorded the participants as they tried to solve this puzzle, and noted that what makes it hard is that people seem to want to fill in one corner of a piece (labeled '*a*' in Fig. 2), which is actually an outside corner in the finished puzzle. This perceptual constraint perhaps comes because of our prior conditioning, and is very difficult to ignore. So much so that people keep going in circles — keep trying the same combinations that did not work — and even when they are given the explicit hint that that particular corner is an outside corner, they still try to fill it in.

There are numerous such examples that are used in various creativity tests. Consider, for example, Guilford's (1967) alternative uses task, where the participants are asked to list different possible uses for a common item like a brick or a newspaper. In order to score high on this test, one needs to think differently, and not in terms of the structures and functions that are usually associated with the object. A slight variant on this is the *barometer question,* which has become more of an urban legend: How to measure the height of a building using a barometer? It is a high-school physics question, and the expected answer is to measure the atmospheric pressure at the top of the building and compare it with the pressure at the bottom of the building. But there are many other answers that score high on creativity: for example, using the barometer as a rock and timing its fall, using it as a weight at the end of a string to turn into a pendulum and measuring acceleration due to gravity, using the pendulum as a ruler, and so on. Most of these answers are based on focusing on surface features of the barometer, and deliberately ignoring its structural and functional features.

Figure 2: The T-puzzle



Given that perceptual and surface similarities provide the fodder for puzzles and such, and structural and conceptual associations serve only as distractions and decoys, let us now look at the situation for real-world problem solving when creativity is called for.

Research on creative problem solving

Research on creative problem solving has also emphasized that to get a creative insight one needs to move away from the existing structure, and its related semantic associations, of an object or a situation. We should note here two unique aspects of *creative* problem solving. One is that the problem seems hard in that one has already tried to solve it through its existing representation and failed. So some unusual approach is called for. The other is that it is not clear if a solution to the problem exists. These two features make creative problem solving quite a different cup of tea from the conventional problem solving. For example, there have been many studies where the participants are asked to solve some math or physics problem, the solutions of which are known to the experimenter, and then the effects of priming or exposure to an analogous problem are

[1] http://motleynews.net/2012/03/24/can-you-solve-this-problem/ Accessed on Jan. 15, 2013.

measured. (See, for instance, Novick and Holyoak 1991.) These studies do not illuminate the creative problem-solving process.

Studies of real-world problem solving (de Bono 1975; Gordon 1961; Schön 1963), on the other hand, provide us a glimpse of mechanisms underlying creativity. They all recognize that the crux of creativity is to move away from the existing conceptualization of the object or the situation. They also acknowledge that it is difficult for people to ignore the conceptual associations that an object almost automatically brings to mind. Generally, two techniques are suggested to break away from the conventional way to thinking. One is to juxtapose the target object or situation with an unrelated object or situation: this is sometimes referred to as *making the familiar strange* (Gordon 1961). The other is to focus on the surface features of the object or situation — so to deliberately not think of it conceptually, or structurally, or functionally, but to focus on its perceptual or surface features. This is sometimes called *deconceptualization* (Rodari 1996).

That deconceptualization plays a major role in creativity is supported by many real-world cases where accidentally noticing surface similarities between two objects or situations suggested a novel idea that later led to a major innovation. One such example is provided by how Ignaz Semmelweis came up with the idea of the germ theory. (See, for instance, Levitt & Dubner 2009.) When Semmelweis was practicing (in the 1840s) at the Vienna General Hospital in Austria, there was no knowledge of bacteria and germs. Many women used to die during childbirth due to puerperal sepsis (childbed fever). Between the two maternity wards at this hospital, the death rate in one of them was more than six times higher than the other one. There were many speculative theories for the childbed fever, like foul air in the delivery wards, the presence of male doctors, which wounded the modesty of mothers, and so on. None of these explained the difference between the mortality rates between the two wards.

The insight came when one professor, who was helping a student through autopsy, received an accidental cut on his finger and died from the resulting infection. Semmelweis noticed that the symptoms were similar to the childbed fever victims. (These were all surface similarities, for there was no structural knowledge connecting the two cases.) A deeper investigation, and some more research led him to formulate a theory of germs, according to which the germs from cadavers were the cause of the childbed fever, and the simple technique of washing hands in chlorinated water before handling the patient in the maternity ward brought down the fatality rate.

The upshot of all this is that the research on real-world creative problem solving shows: (1) The key to getting a creative insight or idea is to break away from the existing structural and functional associations related to the target object or situation. (2) This is difficult because many of these associations are automatically recalled and they pull us in a sort of cognitive rut. (3) Focusing on surface similarities is one technique that people can use to break away from this cognitive rut. (See also, Indurkhya 2010; 2013a).

Two empirical studies on the role of surface similarities in stimulating creativity

We present now two of our recent empirical studies that shed some light on the role of perceptual and surface similarities on stimulating creativity.

Role of algorithmic perceptual similarity in visual metaphors and emergence of features

One of the research problems we have been working on is to assess the role of low-level perceptual similarities — namely similarities with respect to shape, color, texture, etc. — on emergent features when two images are juxtaposed. A feature related to a metaphor is considered *emergent* if it is not normally related to either of the two terms of the metaphor alone. For example, in “Her gaze, a flash of diamond”, ‘seduction’ is an emergent feature as it is not normally related to ‘gaze’ or ‘diamond’ (Gineste, Scart & Indurkhya 2000). A major methodological problem in working with images is in determining the degree of low-level perceptual similarities between two given pictures. One alternative is to ask the participants to rate the degree of perceptual similarities between pairs of pictures, but the drawback is that when we look at a picture, conceptual and perceptual features interact heavily, and it is difficult to be certain that only perceptual features were used in determining the degree of similarity. To address this problem, we turned to image-processing programs.

In the field of machine vision, a number of algorithms have been developed for low-level visual processing. These algorithms extract features (like color, shape, texture, and so on) of images, which are analogous to features found in the early stages of visual processing in humans. So a similarity measure based on these features would reflect perceptual similarity.

We used one such image-based search system called Fast Image Search in Huge Database (FISH), which compares two images based on low-level perceptual features like color, shapes, texture, etc., to get a similarity index for them (Tandon et. al., 2008). We refer to this as *algorithmic perceptual similarity*. For example, consider the pair of images shown in Fig. 3. The image on the left is of the world-famous marble mausoleum *Taj Mahal* that was built by the Moghul emperor Shah Jahan in the 17th century. The image on the right is of wine bottles. These two images were given a high perceptual similarity index by the FISH system. In fact, the wine bottles image was retrieved by the system as a *similar* image when queried by the *Taj Mahal* image. If we examine them carefully, we can see the perceptual similarities: the tall slender minarets of the *Taj Mahal* are analogous to the shape of the wine bottles. However, when people look at these two images, they tend to focus on conceptual similarities, if they find them similar at all.

Using such stimuli, we experimentally studied how perceptual similarities correlate with people's ability to interpret pairs of images metaphorically, and with emergence of new features that are not a part of either image (Ojha & Indurkhya 2009). Our results show that a pair of perceptually similar images (in terms of color, shape, etc.) is more likely to be given a metaphorical interpretation. Here are some examples of the interpretations given to the pair of images in Fig. 3 by the participants: 'Becomes better as it grows old', 'Standing pillars of tradition', 'Beauty in taste', 'Taste of history', 'Taj for eyes, wine for tongue', 'What a waste of time.' We also found that perceptual similarity correlates positively with emergent features.

Figure 3: An example of algorithmic perceptual similarity

Creativity in generating visual arts

In another study, which was a collaborative work with a visual artist (Indurkhya & Ogawa 2012), we focused on the creative process involved in connecting two pictures by painting another picture in the middle in such a way that the trio of pictures forms one smooth portrait. This technique was involved in four *Infinite Landscape* workshops conducted at Art Museums in Japan and Europe by the artist over the last five years. Based on the artist's verbal recollection of the ideas that occurred to him as he drew each of the connecting pictures, we identified the micro-processes and cognitive mechanisms underlying the genesis of these ideas, and surface similarities with respect to shading, texture and shape were found to play a key role in it.

One such trio of pictures is shown in Fig. 4. Here the pictures (9) and (10) were drawn by participants, and the Artist drew the middle picture S9. The Artist recorded the following thoughts on how he came up with the idea for S9 (the Artist's original comments were in Japanese, and are translated here with minor editing by the author): "These two had completely different atmosphere from each other. Sketch 9, drawn by an adult participant, is a scene set at dusk; a person looking at the artist is drawn wearing a sad expression. Sketch 10 has a bright atmosphere with flowers, fountains, buildings on a hill, and a horse. Moreover, each picture had an important character in the bottom left. The idea for connecting these sketches came to me while looking at the wonderful horse in 10. I thought of putting a parent horse running nearby. Because the background color of 9 and the body color of the horse in 10 was the same, I transformed the background of 9 into the parent horse in S9, which became a nested image structure. Then I extended the baby horse and the hill with the buildings."

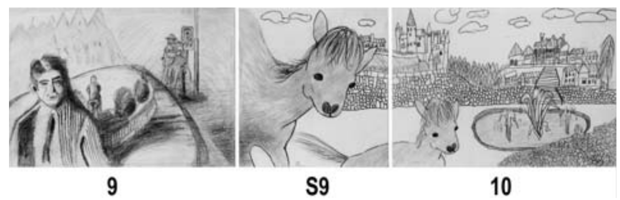


Figure 4: A trio of pictures from *Infinite Landscape* workshop

Here the same shading for the horse's body in 10 and the background in 9 led to the idea that the background in 9 can be morphed into the mother horse in S9, which resulted in an Escher-like nesting of pictures. Thus, this study provides empirical support for the role of surface similarities in generating new ideas.

Conclusions: Thinking like a child and surface similarities

We now return to the main theme of this paper, namely how surface similarities exemplify one aspect of *think-like-a-child* maxim for stimulating creativity. If we look at the perspective from developmental psychology, the progression from surface features to structural features can be explained as follows. As children grow older, they acquire more knowledge of the world and, more importantly, more knowledge of the social norms and conventions. This knowledge takes the form of semantic structures and relationships, and over time, they rely more on these relationships, and surface similarities take a back seat. But as a child gets habituated to some semantic structures, a horde of alternate possible semantic structures get lost. A major part of creativity consists in reclaiming some of these alternate semantic structures — or what Nelson Goodman (1978) would call 'worlds' — that might have been. (See also Indurkhya 2013b.) Focusing on surface similarities provides one mechanisms to go back to the pre-structure stage, so that alternate structures can be found.

It is interesting to point out that this aspect of surface similarities to create new insights is one of the advantages claimed for the case-based reasoning approach. For instance, Riesbeck and Schank (1989, pp. 9-14) compare and contrast three modes of reasoning: 1) reasoning with ossified cases (rules or abstract principles), 2) reasoning with paradigmatic cases (cases with a given interpretation), and 3) reasoning with stories (cases with many possible interpretations and capable of re-interpretations). They argue that it is the third mode of reasoning that displays the most flexibility and power of having a knowledge base containing cases. But in reasoning with stories, one essentially relies on surface similarities, and constructs alternate structures on the fly as needed. Indeed, it has also been noted that surface similarities play a key role in memory access and recall (Barnden & Holyoak 1994).

To sum up, we have made a case for recognizing the role of surface similarities in stimulating creativity. We have also related this to child development, and have argued that it provides one way *to think like a child.* Needless to say, much more work remains to be done in exploring how surface similarities generate alternate semantic structures (see, for example, Schwering *et al.* 2009). We are also exploring ways to design and experiment with creativity stimulating systems that are based on surface similarities.

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