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SIMPLISTIC JOKES AND DRAWINGS AS A GUIDE TOWARDS COMPUTATIONAL CREATIVITY

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Abstract. The purpose of this paper is to analyze creativity in very simple cases, down to its nuts and bolts in order to develop a computationally applicable model. Children's jokes and drawings are observed as the most elementary cases, from which the essentials of creativity can be found without falling into too sophisticated speculative reasoning. Discussion is based on Boden's theory, which describes creativity as a process involving structural changes in one's conceptual space. Here it is refined by saying that creativity is "breaking unnecessary rules in a way that recognizes new rules". Emphasis is also put on search for a comprehensive system model of creativity and creative design, which can then be used to assess the role of different previous theories and computer-aided creativity tools, and can serve as the starting point for computer implementations.

1. Background

Creativity, and particularly creative design, is considered to be a process that results in a recognizable product which is both novel and useful. In other words, it is a generative process with the capacity to perform selection based on recognition of emergent value (McLaughlin, 1993). Phenomenologically observed creativity can typically be characterized as a four-stage process of preparation-incubation-illumination-verification (Wallas, 1926), though this description is mainly applicable to problem solving, and the illumination stage is less distinguishable in the arts. Together these product and process oriented descriptions serve as a framework for creativity research. However, they are on a very general level, and need interpretation when applied to practical cases in different domains and cultures.

The book on creative mind by Margaret Boden (1991) has been influential, inspiring a lot of both unfair criticism and fruitful commentary (Stefik et al,

1995). She describes several examples ranging from scientific discovery (Kekule's benzene molecule) to music (composition by Mozart and Bach), emphasizing that creativity is not producing mere novelty but involves also a restructuring in one's conceptual space. This is what she calls personal or P-creativity, distinguished from historical or H-creativity which indeed requires personal creativity but also cultural acceptance.

Though all design can be considered creative, there is a distinction between routine design and creative design (Gero and Maher, 1993; Gero et al., 1995). This is coherent with Boden's view. Creativity is not just automatic problem-solving or blind search for novel constructions. There must be something more in it, related to conscious evaluation and personal values. Rarity alone is not a measure of creativity.

As recognized by critics and authors mentioned, our current understanding of the term creativity is still very vague and descriptive due to its cultural and situational variability. In order to make it computationally operational, we need a clearer definition, even if it were artificial. Computers are also far simpler than the human brain (even modest estimates, which are anyway inaccurate because of comparing fundamentally different operating principles, give tens of orders of magnitude difference). If we are to make computational models of creativity, they must be based on human activities far simpler than the historically honored great inventions. This is why we are looking for the most elementary cases in this paper, analyzing mundane or simplistic creativity with the hope of finding essential ingredients for a computational general model.

The hypothesis to be discussed in view of the following examples, is that essentially *creativity means to make* different, partially *conflicting views* to a conceptual space, and *to recognize that both are possible* despite of the conflict. Or in other words, it is a process where you first make rules for yourself and then break them, but in a sensible way such that you find new applicable rules. Thus, a product or design in itself cannot be creative, but the way it is found to be novel defines its creativeness.

2. Children's Jokes

Children are supposed to possess a lot of creative power which, unfortunately, mostly becomes suppressed during education and growth to an adult. Thus we can expect to learn something about creativity by observing and analyzing children's behavior. The younger the better, for two reasons. First, there will be less of the above mentioned suppression and more genuine creativity available. Second, the child's mind will be simpler, with less cumulated experience that may confuse the observation. This approach seems to conflict with the often-mentioned fact that creative design requires experience and good domain

knowledge. I believe that such expertise is only necessary for culturally important creations, or H-creativity, but is not an essential element for personal creativity. In the former you have to create something novel for the society, in the latter it is enough to surprise yourself.

Jokes are a good example of creativity. They usually contain a surprise due to a reversal of the most obvious viewpoint. Often the joke is structured in a way that first purposely [mis]leads to a certain view, in order to make the final point more surprising. For the purposes of this paper, jokes are an elementary simplistic form of creative story telling as studied by Ram et al. (in Stefik et al, 1995).

Here is a random sample of schoolchildren's jokes:

> *A man drives along the city beltway, listening to local radio news. "This is on-line traffic report at the beltway. Attention, there is a car driving wrong way against the traffic!" The man says: "One car only? I see hundreds of them."*

And there are hundreds of other jokes with a similar anatomy. The typical story goes as follows. The setting is introduced and the unsuspicious listener assumes everything as normal (the man drives according to traffic rules). Perhaps something unusual but quite possible happens to gain more interest (somebody driving against the rules). Then at the very last moment there comes a seeming contradiction (most cars driving wrong, not just one), which is discovered to make sense only if you drop or reverse a tacit assumption (yes, it was not told that the man himself is driving against the traffic). This becomes the moment of illumination felt as a creative experience, which is fun and brings pleasure.

Though simple, the joke above still requires some imagination to be understood. You have to know about traffic rules and to imagine what it means if you don't obey them. To catch the very essence of humor, let us now go into even more elementary level.

The author has had the opportunity to follow the linguistic development of two-year old twins. Their language use is very rudimentary, yet they understand each other well, and can make fun together. [1]

Usually the twins are called by nicknames "M" and "J". For long time already, they have learned to recognize and consistently use these names. One day we play with them and try to teach them their real names also, by pointing at her and saying the associated pair "M–Mary", doing for him similarly "J–John", and mentioning a couple of other familiar persons' nickname–real name pairs. They get the idea and start repeating these over and over. Then

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[1] This is a true story about my own children, Sini and Timo. Their Finnish-based nicknames are "Tyty" and "Po", respectively, which might be translated to something like "Gal" and "Guy". For simplicity however, in this paper I have changed them to "Mary" and "John".

(accidentally) somebody makes the wrong connection by saying "M–John", stops momentarily and then laughs. The twins recognize that, and soon start repeating different mixed pairs of names, with a lot of laughter – obviously fun for them.

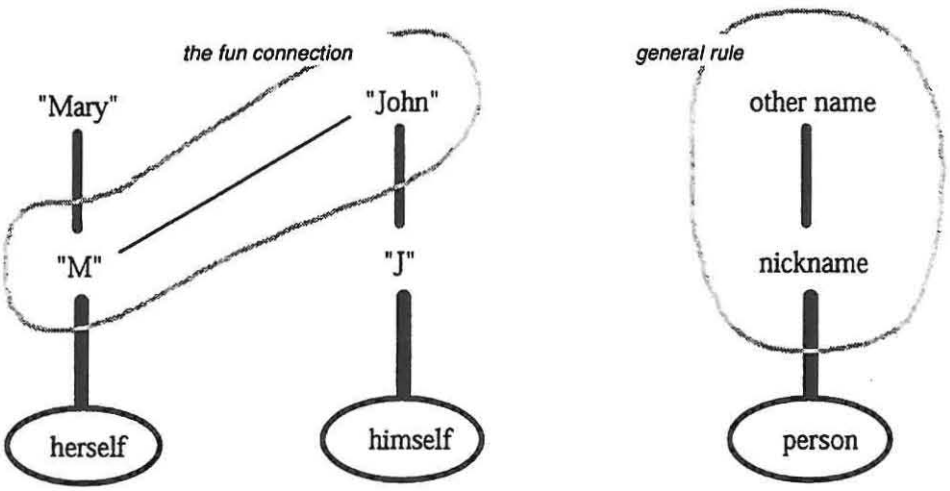

Figure 1. Diagram showing the rule-breaking principle of jokes. The funny association to wrong person obeys the weak general rule and simultaneously violates its learned examples, yet keeping with the strong associations for self-confidence (the strength of is depicted as thickness of lines).

This is a simple enough case to be analyzed in a formal setting, Figure 1. There are strong associations between each child's bodily self and his/her conventionally used nickname. Then weaker associations have been formed from real names to nicknames and implicitly to the personal selves. By induction, they have just learned the rule that a pair of names can be formed to refer to one person. Now if they make a different combination of names, they formally obey this rule but break the other implicit rule that a pair refers to one single person only. Implicitly this also associates to the idea that one person is another, which is a contradiction. Thus the new idea is right and wrong at the same time – a joke is born!

An important observation here is that not every new association is funny. If we call *him* directly by *her* name, he will deny it and react as offended. It would break the stronger himself–nickname association which is part of his self-confidence, whereas the joke only breaks the weaker associations between substitutes of the self. His thoughts might (emotionally, not by formal reasoning) go like this: "it is crazy to call me by her name, but it's OK because I know I'm really not her". A new thought is acceptable only if you can safely keep your self-confidence.

The most simple linguistic jokes (by adults, too) are analogous to the latter example. They are based on the substitution of alternative meanings to a single word. If a substitution makes sense, i.e. the sentence is meaningful but in a different context, the discovery of this alternative meaning is felt as creative. A well-known example (though not a most simple one because it requires simultaneous substitution of multiple word semantics) is the ambiguous sentence "The fruit flies like a banana".

3. Visual Creativity

Another type of simplistic humor appreciated by children (and most adults, too) is the slapstick comedy so often appearing in silent movies and cartoons. If a person falls down, or in any way behaves abnormally, is fun as long as we can confidently believe that there are no serious consequences. We know that the breaking of normal behavioral rules is only a temporary creative alternative. Otherwise it would be perceived as anarchy rather than creativity.

The mimic action comedy can be discussed and explained with words, but fundamentally it is non-verbal. It is based on *tacit knowledge* that we use for understanding the silent action. The same applies to visual creativity in general. On the very lowest level it is based on recognition and emotion rather than cognitive reasoning.

Despite of that, we can try to analyze visual creativity. However, we have to avoid too sophisticated fine arts, as they are so much convoluted with social and cultural situation and history. Instead, we try again to find the most simplistic cases that yet can be called creative.

3.1. EXPLORATIVE VS. REPRESENTATIVE ART

A child's artistic development is first purely explorative. On one hand he/she learns to recognize different shapes and patterns (human face as a most important one) not only in real objects but also in substitutes like paintings and drawings. On the other hand the child learns constructive action, how hand motion together with pens, brushes or other tools will result in visible products. The action becomes representative art, once the child starts to see familiar images in the medium. Later, when the connection between a recognized shape and the action that produced it has been established, and a purely imagined figure can deliberately be reproduced by physical action onto a medium, the act can be called *design*.

The most familiar figures like humans, animals, houses, cars, etc. depending on the culture, are usually learned (often taught) to be drawn in a certain way. They are then governed by compositional and procedural rules, which may even

override look-alike similarity. The drawings become stereotypic iconic symbols – kind of visual semiotics that often can be seen in comics, for example.

To which part of this development can we associate creativity? Is it just the production of any new image, or does it have to be a purposeful action for representing something? Are you creative if you look at the clouds and imagine to see there animals or other familiar shapes, or do you have to produce the image with your own hands?

I bet there is no absolute answer to these questions. However, I think that most concerns about the product itself and who produced it are irrelevant. Rather I like to follow the theoretical approach that *creativity comes from the recognition of alternative ways to see things*, and that finding an alternative requires a change in one's conceptual structures. The latter requirement implies that there exist rules governing a first interpretation of an image, and that the alternative interpretation only makes sense if you change some of these rules.

To this basic principle I would like to add that the "rules" subject to change are only tacit assumptions, not strict explicitly given rules. In visual creativity these rules can be either naturally inborn perceptional rules or culturally developed semiotic rules. Breaking either or both of them is always possible, but not very probable. This is why creativity is considered a rare phenomenon.

3.2. THE RABBIT DUCK

Nice examples of creative imagery are ambiguous dualistic figures like the "rabbit duck", Figure 2, also mentioned by Mitchell (1993) and Cross (1995).

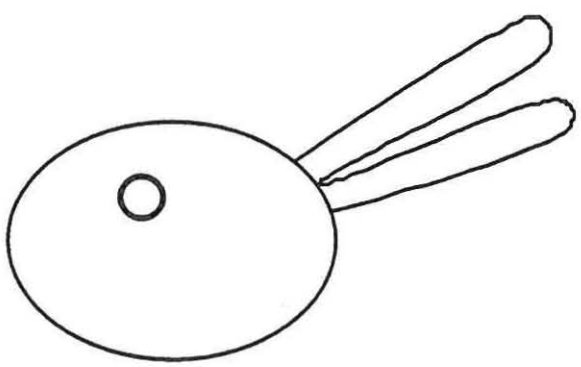

Figure 2. The rabbit duck.

In the figure you can perceptionally find various subshapes: a round central shape with a small round part inside it and a double elongated extrusion emanating from it. Semantically you associate with high probability the round shapes to an animal's head and eye, but the extrusion can take alternative meanings: either a rabbit's ears or a duck's bill. Separately each interpretation

makes sense, but simultaneously they form a semantic conflict. Yet an additional conflict is that the rabbit is facing left whereas the duck is looking at right. The first-time recognition of alternatives in a dualistic image is typically felt as a creative experience, analogous to understanding the double meaning of a joke.

Learning is an essential component in creativity. In a dualistic image you may first see only one interpretation, but once you have discovered the alternative, it immediately comes in mind when looking again at the same image. However, though the first-time creative moment appears only once, it can be recalled and appreciated over and over.

3.3 NINE DOTS REVISITED

As a second example of how the visual perceptional rules relate to creativity, we take the well-known 9-dot problem. Its solution is supposed to involve creativity, as discussed also by Akin and Akin (1995) and Turner (in Stefik et al, 1995). The problem setting is shown in Figure 3a. The task is to draw, without lifting the pencil, four consecutive straight lines such that they visit all nine points. The solution Figure 3b is not easy to discover, but becomes immediately clear and easy to remember once you have seen it.

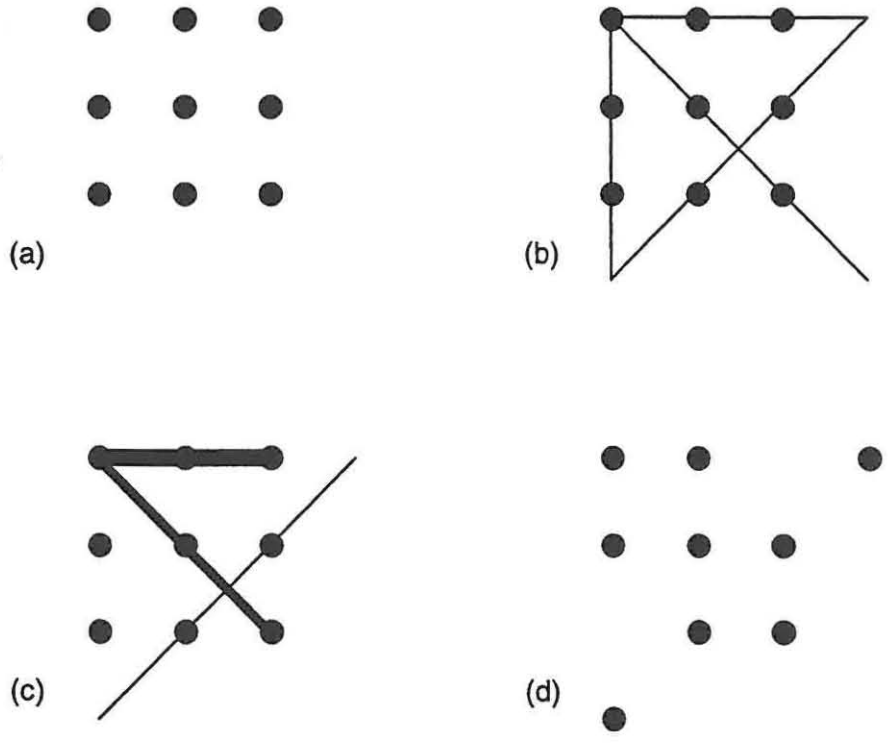

Figure 3. The 9-dot problem. (a) original setting, (b) the solution, (c) some more and less obvious lines required for the solution, (d) alternative setting containing visual hints

As previous studies have shown, the problem setting generates a strong implicit assumption that you have to stay within the square bounding the dots. Even if you are verbally hinted that you are allowed to go outside the square, many test subjects do not use this information. The creative leap then comes once you break this implicit rule and allow yourself to find different solution candidates.

Turner refers to two psychological tests, where no evidence was found that the hint "go outside the square" would help to solve the problem. From these studies he concludes that the conceptual restructuring suggested by Boden is not a key element in creativity. I think this is premature and too straightforward. Instead, one should analyze, *why* the test subjects make the implicit tacit assumption, and check if the single hint given was sufficient in that light.

During the course of a similar test, the Akins gave additional hints in two phases, first showing a partial solution which, however, confined within the square area. The second hint verbally told that you may draw additional points if needed. The researchers found that these helped the subjects, and concluded that the solution requires more than one constraint relaxation (first to get out of the box, second to build new vertices, and third to align these with the existing vertices).

So what in the problem causes so strong implicit assumptions that special help is needed to solve it. If we analyze which well known Gestalt rules might apply to the visual problem structuring and confuse one's mind, we easily find at least the following:

- *proximity of points:* first connect dots that are nearest to each other (i.e. try vertical and horizontal lines only), later try diagonals and other oblique lines
- *closed shapes:* a line must start and end at a dot (thus connections of consecutive lines are restricted to the given dots)
- *proximity and closedness*: stay inside the convex hull area (the bounding square) of the set of dots
- *continuity of lines*: prefer lines connecting more than two points
- *continuity and the given restriction to construct a single line sequence:* avoid more than two lines emanating from a point (only a single visit by the sequence through each point)

So the bounding square is not the only implicit restriction. We can see from the above that for several different reasons some lines are much more probable candidates than others (shown by varying line thickness in Figure 3c). Particularly the long thin oblique line is very improbable, but it is necessary for solving the problem. This is why the problem is tough and calls for a creative leap.

In order to check these claims, I made a quick test (just among friends, not a formally conducted experiment), where I observed subjects' behavior and gave for comparison a modified version of the task with visual hints, Figure 3d. This version was specifically designed to relax the implicit constraints of staying inside the box and drawing lines only from vertex to vertex.

It appeared that the visual gestalt rules are much stronger than their verbal counterparts. Even though I explicitly told as hint in the original case Figure 3a that the lines can go outside the square, some test subjects reacted after seeing the solution: "Oh, I didn't know it was allowed to go outside the box". Instead, the modified version Figure 3d was easy to solve, because the important diagonal line (thin in Figure 3c) is immediately perceived as a probable candidate. Interestingly however, some subjects could not transfer the solution from Figure 3d to Figure 3a, because they perceived the modified case as a square with diagonal, and got stuck with the analogous diagonal of the smaller square in the original setting, Figure 3a.

My conclusion is that the case is not as simple as it seems, but calls for further more detailed studies. A particular issue is that the 9-dot problem becomes a cross-modal puzzle, if rules of the game are given verbally. The analysis would be easier if we could stay within one modality only. But how can we give the rules in a purely visual form? It is possible by showing examples, from which the rules are inductively learned.

4. Discussion: Where is the Creativity?

Creativity is not just to generate something that has not been there before. Nor is it just a single different viewpoint. What makes "real" creativity different from mundane novelty or totally free artistic improvisation is that you must break some rules in order to be creative, even though the rules are not absolute and may exist only tacitly. You have to know (by feeling) that there are conflicting alternatives, that some rules are to change from one view to the other. The confrontation of an alternative view against a dominant one has been emphasized as a source of creativity by de Bono (1967) and even more explicitly by Killander and Sushkov (1995).

The point may be clarified if we consider algorithmic art: a person makes a computer graphics program that automatically generates abstract images, and puts a selection of those into an art exhibition for audience to look at Figure 4. Now who is the artist in this situation, or which part of the process is creative?

We may consider the programmer as the original source of creativity. This may be the case if the programmer acts as a *designer*, having an idea in mind which he then reproduces with computer code. However, if the software is very complex, applies random variation, or even modifies its own code, the

programmer cannot know in advance what actually will be generated, and probably cannot be called the artist.

Next, the computer system that physically generates the artwork could be considered the creative part. Indeed, it may automatically generate quite creative results using genetic programming (Sims, 1991; Gritz and Hahn, 1995), but who knows that they are creative? For a genetic algorithm, the fitness function has to be given from outside. So we need external critics at least.

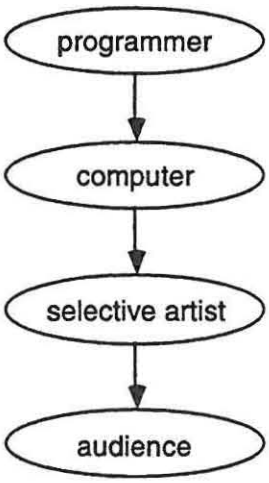

Figure 4. The problem of algorithmic art: who is the creative artist?

Normally the person who selects what to present as art is called artist, even if he/she has not produced the work with own hands. This may also be somewhat controversial. If Andy Warhol randomly picks a Coke can and exhibits it as his own artwork, is he a fraud? I would say no, if he exercises the selection method systematically and that way induces a novel viewpoint in art or even a new style with its own rules. In that sense he is creative.

Well, a novel viewpoint to himself or to the audience? Maybe either or both. An artist (or scientist, or any other) can be personally creative and develop a new style alone, but historical creativity calls for social acceptance also. This means that the artist's personal creative leap is reproduced in the audience as an illumination. Then it becomes part of cultural heritage and the artist is called H-creative. — Or is it possible that the artist did not mean the same thing that the audience understood, or did not consider his works creative art at all? Incidentally, yes. In that case we can legitimately say that actually the audience was the creative party in the system.

After all, we could not point out a single creative part in the process, but rather there may be several. What we learn from this is that creativity is very

personal and situational. It is more recognition than generation, and depends on one's previous knowledge and beliefs.

As yet another example supporting the conclusion above, let us take H.C. Andersen's tale about the Emperor's new clothes. There a child makes the remark that the Emperor has no clothes at all. For the child himself, this is nothing but saying aloud the obvious. For the Emperor and his court, this is politically incorrect and thus unacceptable. For the public opinion instead, the remark is creative, as it reverses an official belief that then appears to be not a logically necessary fact.

4.1. SO WHAT?

For now, I would take as a working definition that *creativity is the ability to see things in alternative sensible ways and to recognize these as different interpretations*. In more technical terms, it means to learn one set of rules (regularity in a system) by exploration, and to recognize another applicable set which somehow conflicts the first. Any system that builds a (personally) new but acceptable point of view by deliberately stepping out of the conventional, is creative.

Such creativity definitely appears in humans. Can we put that function into a computer also, and not only the more or less mechanical generative processes? I believe this is possible, if we can identify the necessary and sufficient components for a creative system. Implementing these in rudimentary form inside a computer will bring us a model of simplistic creativity. Below I outline a proposal of what the essential system components might be:

- *A workspace for representing data and knowledge.* This is a necessary basis acting both as a long-term memory where experience is collected and as a short-term memory for temporary trials to be handled as alternative interpretations. Related to creativity, an important feature is that several (short-term) working memories act in parallel, each holding its own subset of knowledge and representing a different view to the data.
- *A learning organizer.* This part contains pattern recognizers that find regularities in the data and build rules out of them, to be stored as temporary interpretations in the parallel working memories. This subsystem may also work actively to generate new data according to the rules. Controlled by the next level, rules in a view may come and go according to their relative importance and consistency within the view.
- *An evaluating comparator.* This component performs three kinds of functions that evaluate and control the interpretations built on the previous level. First, it checks that each interpretation is sensible and consistent in itself. Second, it looks for differences and potential conflicts

between them. Third, it assigns importance values to the knowledge items. These are not the probabilities of rule usage in an interpretation, but rather measures of the rules' persistences. They are either built-in values or results of a slow evolution through interaction with the system's environment.

- *The creativity recognizer.* Based on the previous level's measures, this part detects when the conditions for creativity have been met. If it finds two parallel interpretations that are partly similar (using same rules of high importance value) but different in a conflicting way (there are rules that have high probability in one interpretation and their opposite rules are used in the other), and each is internally consistent, it indicates having a creative experience. Mechanistically this might be displayed as flashing a light or playing a laughter sound.

Such a computer system does not yet exist. Research has been done and many different methodologies developed on the first two levels. Rule systems and different data structures are there for representing things in different application domains. Learning systems and pattern recognition have been developed based on both logical reasoning and statistical methods, and various generative algorithms exist also.

But not much can be found for the third level, though one might imagine it to be quite feasible on top of existing knowledge engineering techniques to build the mechanisms described above. Why is it so difficult? I think the key concept missing here is a model of beliefs. We need judgments of knowledge importance, which are not based just on logical reasoning. Something that Penrose (1989) is looking after in his critique against hard AI. He borrows Andersen's metaphor and lets a young man ask the ultimate computer: "How does it *feel* like?" Despite of his somewhat pessimistic conclusions, I think that the question is valid, and that his argumentation only applies against traditional knowledge engineering. We may get more progress by putting emphasis on non-verbal tacit knowledge, perhaps using neural techniques (Takala, 1993). So new research is still needed. After that, as we have all the lower-level ingredients available, the fourth part of the proposal will be simple to implement.

One may note that in the proposed plan there is no component that generates creative designs. It could be either implemented as a separate entity, or embedded in the pattern recognizers and interaction between system components, as attempted in my previous work (Takala, 1995). Though important in practice, the generating function is neglected in this paper for emphasis: creativity is considered to exist in the process, not in the product. It is a situational opportunistic activity that may recognize alternatives anywhere. Once we have a computer system that can understand and laugh to even a most

simplistic (verbal or visual) joke, we will be much closer to computational creativity than today.

Acknowledgements

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