PROCEDURES AND STRATEGIES:
CONTEXT-DEPENDENCE IN CREATIVITY[1]

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1. Introduction

Research on creativity can be done from several different perspectives. You can think of creativity as producing products of historical impor- tance, or, in an everyday sense, as something people engage in during daily life. You can concentrate on the psychological characteristics of creative people, talk about the kind of sociocultural environment that would constitute a fertile soil for such people, discuss what counts as a creative product, or suggest methods for enhancing creativity.

In this article, I focus on creativity as a cognitive activity. I am interested in the cognitive processes that lead to the making of products that count as creative. Typically, such products are novel, unexpected, and productive in that they open up new areas of investigation or of behaviour.

Seen as a cognitive activity, creativity involves much the same elements as problem solving, that is, knowledge-representations, rules for manipulating them, standards for evaluating solutions, and a halting rule that puts an end to the search.[2] Problems arise when knowledge is in-

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[2] The rules that are used in manipulating knowledge-representations in order to reach a creative solution to a problem are of a certain kind. I distinguish between two kinds of rule: intra-representational and inter-representational. The former kind covers transfor- mations of knowledge-representations that concern form, modality, and organization, while the latter pertains to transfers of content or structure between representations. Such transfers are based on similarity judgements. See Brinck 1997a. Note that the concept of

coherent or insufficient, in the sense that there is a clash or a lacuna among the set of representations supposed to cover a certain area.

The concept of problem solving should be taken in a broad sense when applied to creativity. It involves as diverse phenomena as cooking, problem solving within mathematics and science, and inventing games. Problems come in a wide variety of guises. Common to all of them is an undecided or uncertain situation that emanates in a question, that not always is explicitly formulated in words. The solution simply consists in an answer to that question, an answer that does not necessarily have to be in words either, but can consist in some kind of behaviour or in an action.

The elements involved in problem solving have quite a different character in creativity as opposed to normal cases, due to the open-ended character of creativity. In situations that demand creative solutions, the subject has incomplete information about the knowledge-domain and how she should handle it to produce an effective solution to the problem at hand.

The subject of the present article is the nature of the knowledge-representations. Recently, it has been suggested that at least some kinds of mental representation are strongly context-dependent. Not only what is represented, but also how it is done, depends on the context and the subject's interaction with it. Theories about situated cognition stress the importance of the subject's bodily presence and physical activity in the environment for representing and thinking.[3] What does this mean for creativity? Context-dependence can, it seems, both impede and support creativity. Is creativity a higher-level cognitive function, or does it mainly rely on good old-fashioned know how?

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manipulation should not be taken in a literal sense here. The subject does not normally operate directly on the representations that reflect a certain problem. In many cases, solutions depend on cognitive processes that are outside the reach of the subject. It is nevertheless possible to train people to become more successful in problem solving, by, e.g., formulating the problem in a certain way, or by using particular step-wise rules of thought.

[3] The extreme position asserts that we do not need to posit representations in order to explain cognition. See e.g. Beer & Gallagher 1992; Brooks 1991a and 1991b.

2. What is a context-dependent representation?

When I talk about representations, I have in mind something that carries information stored in a certain form and realised in some specific medium. More specifically, I intend so-called mental representations, entities that are instantiated in systems, living or artificial, and that carry information that helps these systems to cope with and survive in their environment.

I will not discuss how representations are able to represent, or carry content, as by similarity, functional or causal role, and so on. I will also avoid discussing the form of such representations, that is, whether they are symbols, patterns of activity, or, for instance, images. The theory put forward here is intended to be neutral on these matters. But the attentive reader will notice that I have a penchant for theories of representations that are compatible with the connectionist paradigm, and also that definitions and ideas put forward in this text exclude some theories and presuppose others.

The focus is on the content of representations. The question is how a content's being dependent or independent of the immediate context of the subject will influence creative thinking.[4]

There is no denying that context-independent representations are necessary for creative thinking. Typical for creativity is not only counterfactual thinking and imagination, in which the source of the content may not even exist, but also the capacity to transfer knowledge or information between domains. These domains may carry information about sources that are not present in the subject's near environment.

If a subject only can think about what is present in her surroundings, she will not be able to come up with any problem solutions that transcend the given. This will not only make her solutions predictable. Moreover, her solutions will not answer to the demand for novelty, a property that

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[4] Note that the question of context-dependence or -independence is not the same as the one concerning externalist or internalist theories of content. Externalism asserts that content is dependent on the referent, but, according to externalism, the referent does not necessarily have to be present in the immediate context of the subject, as is maintained by the theories dicussed in this article.

is characteristic of creativity.[5] There are also other cognitive processes necessary for creativity that require context-independent representations, for instance, categorisation, long-term memory, generalisation, and meta-cognition.

The question is whether creativity is furthered if context-independent representations are accompanied by context-dependent ones. To answer this question we first have to characterise context-dependent content.[6] Let me begin by defining the notion of context. The *context* contains a time, a place, a source of information, and at least one subject, who will also be the subject of the representation.

I will say that a *content* about a certain source is *context-dependent* if it i) occurs only when the source is present in the context of the subject that entertains the content, and ii) is shaped by the kind of interaction that takes place between the subject and the source, and thus by the physical constitution of both source and subject as well as by the function or use that the source has to the subject (since the interaction depends on these factors).

This means, among other things, that context-dependence demands both situatedness and embodiment on behalf of both subject and source.[7] There is a causal relation between the representation and the source, and

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[5] Margaret Boden has made a distinction between person-related and historical novelty. The former kind concerns novelty in relation to the person who has produced a solution to a problem. The latter concerns novelty in a much wider context, where the product is of general historical importance. I am mainly interested in the former kind of novelty. Nevertheless I believe that the basic cognitive processes involved in creativity are the same whether the resulting creative product is novel in a personal or historical sense. *Cf.* Boden 1991.

[6] Here I make use of a strong concept of context-dependent content. It has its upshot in theories about so-called situated cognition that have become increasingly popular within cognitive science. According to these theories, it seems that we rely heavily on receiving information from the immediate environment (instead of on such that we carry with us in memory) in resolving what we often conceive of as simple tasks in everyday life, such as finding a path through the terrain, cleaning up, or driving the car.

[7] Situatedness is simply the idea that the content of particular thoughts depends on information in the context that the subject is placed in physically. The source must be present in that context. Embodiment means that the capacity to represent and think depends on perception and (bodily) interaction with the environment. *Cf.* Ballard e.a. 1997; Brooks 1991a and 1991b; Johnson 1987; Lakoff 1987; Maes 1995.

the content is subject-relative, or individual. The latter point results from the fact that the content is constituted by the physical and functional relation between subject and source. This phenomenon is sometimes called coupling. The same source can give rise to radically different contents dependent on, by turn, the time, place, subject, and on-going interaction.

Note, finally, that *context-independent* representations do not depend for their existence on that the source occurs in the context of the subject. This independence allows for the kind of transfer of content and mapping between domains that constitutes one of the conditions for creative thought.

3. Pros and cons of context-dependent thought

In several ways, context-dependence facilitates creativity. For one thing, it is economical and parsimonious to use information that is accessible in the context both as regards time and processing efforts. Memory costs can, for instance, be reduced by making changes in the context of observation instead of storing information in memory. An example of this is when we, while counting coins, regroup them in piles or heaps in order to keep track of the amount (*cf.* Kirsh 1995).

The search for a solution to the problem at hand is also easily delimited in case the problem solver only works with information available in the context. The situation is easy to take in, as are any constraints set by the context on the search. This may enhance creativity, in the sense that a subject who is sensitive to these factors and is capable of taking them into account will know in what direction to look for the solution. Constraints can promote creativity, because they provide the subject with clear indications of which lines of thought to pursue and which to abandon.

Context-dependent representations are also valuable in order to counterbalance context-independent ones, since the latter may be inhibiting. The latter are often used in producing a problem definition and constructing a goal to which the solution as part of a procedure is supposed to take the subject. Such fixed representations can be transcended with the help of contextual input. In many cases, it will be worthwhile to avoid letting the search for a solution be guided by a carefully worked

out plan, since the plan may control the search and thereby suppress new ideas.

Furthermore, the context does not only provide information about the problem, but it also suggests how it can be solved. Let me illustrate this by way of an example. Say that you are going to build a hut in the woods. You will have to make do with the material that you find there. The material will determine the kind of hut that you can make, while your experience and knowledge about this area will determine the quality of the final hut. In this sense, the material will provide you with means and alternatives among which you can choose, and which you can make use of in developing your strategy.

A different kind of example is how, when experiments are conducted in science, the available technique and instruments will put up constraints on possible outcomes, but also suggest further hypotheses and experiments, as well as guide the understanding of the actual outcomes.

But context-dependence is not only helpful. It may also render creative thinking more difficult or in extreme cases even exclude it. The reason is that the context reduces the scope for action and determines the kind of information as well as how much information that is accessible. The same factors that have positive effects in one kind of setting may be harmful in another.

Context-dependent representations are reactive, or stimulus driven. They depend on what the subject perceives in her environment. But their character is also influenced by the kind of over-all activity that the subject is engaged in.[8] A. Clark maintains that representations often are action-oriented, and that perception is "geared to tracking possibilities for action" (1997, pp. 50). Such representations simultaneously describe the circumstances and prescribe appropriate action, by representing the conditions in such a way that they seem adapted to a specific action. This means that perceptual content is presented or conceptualised relative to the action that the subject needs to perform (Clark 1997 sections 2.6 and 8.3; see also Brinck 1997b, ch. 5; Varela e.a. 1991 ch. 8).

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[8] Already M. Merleau-Ponty emphasized the active and intentional, but nonconceptual, nature of perception, as in the following quotation: "In so far as the body provides the perception of movement with the ground or basis which it needs in order to become established, it is a power of perception, rooted in a certain domain and geared to a world." (1962, p. 279).

D. Ballard has pointed to another characteristic of context-dependent representations (Ballard 1991; Ballard e.a. 1997; *cf.* Clark 1997, p. 150). He calls attention to their idiosyncratic nature. In a particular setting and in relation to a particular action, the subject focuses the attention on the object by a deictic strategy. This means that a certain sensory mode, like vision or audition, which is particularly salient in that setting, is used to identify and pick out the object in the context, in order for the subject to achieve the goal. Such deictic pointers dynamically refer to points in the world.

For instance, when you are looking for your car in the parking-lot, your search may be guided by its colour. But colour is not a feature that in general is used to identify cars. It can help you single out your car in a particular context in which there are no similar objects with similar colour, but it is not a generalizable feature that can be used for finding cars as such.

The idiosyncratic and action-oriented nature of context-dependent representations makes them adapted to a particular purpose. For this reason they are less suitable for the metaphorical (although not necessarily linguistic or conceptual) and general style of thinking often used in creativity. They help you search for or track a certain phenomenon, but in doing so, they make you less open to possible connections with other domains of the phenomenon of which you are thinking.

The context may also impose restrictions on a subject's behaviour in case the subject is used to deal with it in a certain way. How previous experience can obstruct creativity was demonstrated already in 1931 by N. Maier (Maier 1931; see also Stein 1989, p. 164). In his experiment, people were asked to tie together two cords hanging far apart from the ceiling. A set of pliers were available to help them, in order to make the cords swing like a pendulum, thus making it possible to reach both cords. But the subjects had difficulties coming up with the pendulum solution, presumably because their previous experience with pliers as tools prevented them to use the pliers as weights.

The phenomenon that occurred in Maier's experiment is sometimes referred to as functional fixedness (*cf.* Stein 1989, p. 164). It prevents the transfer of information between domains that is of such importance for creativity. If an object has received a certain function, it is hard to assign another one to it. The context calls forward previous experience with information and task, thereby initiating a routine behaviour that overrides

any impetus to be creative.

B. Stein points out that

> from a contextualist perspective, the creative transfer of knowledge is constrained by both the context in which the information is to be used and the context in which the information is learned. (1989, p. 165)

The subject has learned to use some particular information for a specific purpose, and she has also learned to deal with a certain kind of context in a specific way. This is, as well, a common phenomenon in science, where training and available techniques and methods push the research in a certain direction.

In extreme cases, the task itself excludes creative solutions. An example is riddles, another one jigsaw puzzles. The puzzle itself contains all the information there is to be had about the task, and the rules for how to put the puzzle together are given from the start. This is all you have to know to "solve" it. The context leaves no room for creativity. All the parameters are set, and if you change them, you change the rules, and then you are no longer playing the same game.

There is such a category of "problems" that each only have one solution. If you try to give another, and transcend the rules or make use of other data than the given, you will break out of the frame-work that defines the task. The task will then change or simply cease to exist.

To conclude, context-independent and context-dependent representations will together enhance creative thinking. One might say that they cancel each others drawbacks. To be creative the subject must not exclusively entertain context-dependent representations. Creativity relies on the capacity to free one's thoughts from contextual constraints. Context-independence makes sure that the subject will be able to rise above the predictable. Context-dependence, on the other hand, ensures that she will find a "cheap" solution in reasonable time.

4. How context-dependent thought may contribute to creativity

In this section, I will describe in greater detail how context-dependent representations may further creativity. There are two basic ways in which such representations may contribute - either by taking care of routine

behaviour and thus making it possible for the subject to focus on important subtasks or higher-level strategies, or by effectively guiding the search for a solution.

Let us take riding a bicycle as an example of the first case. It is (when you have learned how to do it) an automatic action, but nevertheless it requires the subject's attention. All the senses cooperate in guiding the subject through the landscape. The attention is attracted by the surroundings and the bike, but the subject can focus on other things, like thinking about what she is going to buy for dinner. The action is situation-determined, which means that the conditions for riding the bike is set by the context, not by planning beforehand, and that the action does not have to be consciously monitored.[9]

As an other example, take tennis, an activity in which the need for creativity is more obvious (at least if you desire to win the game). If you are used to playing, you automatically run for the ball and hit it, while concentrating on what will be coming up next and on the player on the other side of the net. To hit the ball, you do not need a plan, nor an enduring and detailed model of the environment. Your representations of the environment are constantly changing, in pace with the changes that take place around you.

In situations of this kind, perception seems to be taken care of by nonconscious, special-purpose routines that intertwine sensing with acting and moving (cf. Clark 1997, p. 27 ff). Riding the bike and playing tennis are taken care of by information drawn from a procedural memory together with the constant input from the context. The success of both activities depends on the skill of the subject.

It is easy to make comparisons with experimenting in science. The scientist does not normally concentrate on how to execute different parts of the experiment, but is familiar with the apparatus. She focuses on the crucial elements of the experiment (which may differ depending on the situation), while routine behaviour takes care of the rest. Experts, in virtue of their skill, are able to devote more attention to anticipate future events than the novice. Context-dependent representations automatically take care of immediate actions, while the subject can focus on higher-

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[9] In *The Indexical 'I'*, I suggest that representations carrying nonconceptual content guide behaviour in situations similar to those described in the text above. See ch. 5. See also Brinck 1999.

level strategies.

Skill obviously constitutes an important part of expert-knowledge. It makes it possible for the subject not only to concentrate on the vital issues, but also to perceive relationships among items that have to be calculated by less experienced subjects. A. de Groot (1965) has described how master chess-players directly perceive the situation on the board. It is plausible to assume that this capacity to form immediate judgements about the position is based on pattern-recognition and perceptual inferences, instead of, as in the case of the less experienced player, propositional inferences.

Making immediate judgements of this kind has several advantages. It leaves more time to think of the strategy and it excludes fallacies resulting from miscalculations. Furthermore, as opposed to propositional inferences, perceptual associations rest on analogy, metaphor, and iconic relations between perceptual symbols. Such associations can give rise to insights that are not accessible to the novice, who is, in a sense, trapped by her calculations (*Cf.* Brinck 2000).

The second way in which context-dependent representations may contribute to creativity is by guiding the search for a solution. In that case, the subject may deliberately try to ignore background knowledge and the usual procedures for solving problems, and instead let the actual context guide her thoughts and actions concerning the task at hand. The point is to exploit real-world structure in a way that enhances creativity instead of blocking it.

In an article about tool behaviour, T. Wynn brings up a study of blacksmithing. According to Wynn (1993), this is a kind of craft that requires problem solving. Wynn defines problem solving as "the ability to adjust behaviour to a specific task at hand" (1993, p. 397). Blacksmithing is an excellent example of how manipulating external objects may further creativity. The making of different objects, as, for instance, a fleur-de-lis, a candlestick, or banisters, is determined by several things, among others "aesthetic, stylistic, functional, procedural, [and] financial" standards together with the material conditions. Wynn writes that there is a constant

> feedback between the image of the task and the actual events of the
> process. The goal must be constantly altered, however slightly, in the
> light of developments in the procedure, which in turn affect other

> elements of the constellation. It is a dynamic relationship that could not
> be accomplished by rote memory. (1993, p. 397)

One might add that the task could not be achieved by context-independent
representations either. Success relies on the constant flux of dynamic and
variable representations. The strategy involved is rough and very general
not to interfere with the process.

Compare Wynn's description of how the blacksmith creates a new
object with how the scientist discovers a new phenomenon.[10] The dif-
ferent processes have much in common. The same sort of standards are
used in both cases,[11] and in both cases there is a constant interaction
between theorising and experimenting. In this process, discovery and
justification will follow on each other as in a spiral, leading to a final
acceptance of a particular solution.

R. Giere (1988) has pointed out that the instruments used in perfor-
ming experiments embody background knowledge. They are designed
with certain intentions that build on the common knowledge and prevail-
ing theory of the scientific community. When the experiments are per-
formed, the results may cause changes in the theory, which in turn will
cause a change in equipment, and so on. As I see it, this development
constitutes a kind of loop, in which discovery and justification as well
take part.

Wynn notes that as the behaviour required to achieve a task is repeat-
ed over and over again, the dynamic interplay of elements and goal is
replaced by an "almost unconscious recipe". This is when the behaviour
has become a routine and no longer contains any creative elements.

In the kind of case that Wynn describes, it is quite evident how the
subject uses the external context to "reason" about the task. This activity
is the opposite of executing centrally produced instructions or of the
implementation of plans made up beforehand. We do not only use the
external world as a tool in reasoning when the problem we are grappling
with is of an aesthetic, physical nature, as in the arts, in craft, or in
design. We often manipulate objects and have them stand in for other

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[10] One might object that while craftsmen invent their products, scientists discover theirs.
But a theory may prepare for a discovery and even in a sense create a phenomenon by
suggesting a certain interpretation of natural events.

[11] Compare with the heuristic principles used in science.

things when we try to devise new solutions. If nothing else, we grab a note-pad and scribble, in hope for inspiration.[12]

Whether we are trying to invent new dishes and recipes, new medicines, or perhaps a new kind of vehicle, we use methods that summon the external world to take part in the activity. It does not matter whether we are working on a new theory or a new design, the process is similar, since theory involves practise to the same degree as practise involves theory.

We continuously try out and develop new aspects of the product in a dynamic interplay with different elements in the environment. This also makes it possible for us to judge the quality of the product with our different senses. The final solution will be a result of an interaction between exactly those factors that were mentioned in relation to blacksmithing: aesthetic, functional, procedural, financial, and material conditions. In some cases, we may also add ethical considerations.

Varela, Thompson, and Rosch once remarked that

> if we wish to recover common sense, then we must invert the representationist attitude by treating context-dependent know-how not as a residual artefact that can be progressively eliminated by discovery of more sophisticated rules but as, in fact, the very essence of *creative* cognition. (1991, p. 148)

This remark is on the spot. Models of cognitive processes have for a long time described the mind as containing a complete and to a great extent static, inner map of the external world, which the subject uses to reason about states of affairs and to plan for actions. In real life, however, planning ahead is often difficult or even impossible, and fixed descriptions of how to reach a pre-defined goal are not of much use. Intelligent agency must be tuned to the constantly changing context in order to be successful.

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[12] *Cf.* Kirsh 1995. Kirsh argues that people recruit material objects in the external environment to amplify their cognitive abilities.

5. Creativity as a distributed activity

There is no doubt that the context is of use in problem solving. The capacity to detach oneself from the context is often emphasized in discussions of creativity, but the role of the context should not be neglected. Creative uses of the context differ from everyday routine use, but, it seems, not as concerns the actual mode of thinking, but rather as a matter of degree and intent on behalf of the subject.

As mentioned in the last section, there are two ways in which the context can contribute. The subject can either let the context have the lion's share and take care of most of the activity in the context, while she can concentrate on and reason about subtasks of particular importance or the overall strategy, as in playing tennis or chess. Or she can deliberately avoid to reflect on the problem from a theoretical perspective and instead toy around with contextual elements. In the first case, the subject behaves strategically, in the second, she is open to solutions suggested by the context. We may call the kind of creative thinking at play in the first case *strategic*, and in the other *procedural*.[13]

As depicted here, creativity constitutes a kind of distributed activity, in which the actual solving of the problem is shared between the subject and the context. I will let Clark summarize the discussion:

> Once real-world problems are confronted in their proper setting and complexity, it becomes clear that certain styles of problem solving simply will not work. And the kinds of solution that *do* work often merge the processes of reasoning and acting in unexpected ways, and cut back and forth across the traditional boundaries of mind, body, and environment. (1997, p. 68)

One of the fundamental rules for succeeding in solving inscrutable or

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[13] What I call procedural creativity should be distinguished from the kind of thinking in which you let your thoughts float freely in a random search for inspired solutions. So-called free-wheeling is typically context-independent. It also relies on a distinction between contexts of discovery and justification that is alien to the nature of procedural creativity. *Cf.* Lamb 1991, p. 58 f.

intractable problems is to be sensitive to constraints as well as lacunae in the context.

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