The case of cognitive ecology for cognitive processes in everyday life situations

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Abstract

Cognitive ecology is a term that has been used in environments that are more tightly coupled and purpose-specific than environments of everyday life. In this paper I consider cases from a cognitive ethnography of older adults. These cases show the analytical use of understanding the diachronic and synchronic cognitive ecology in which cognitive processes of everyday life occur. Specifically I discuss how the social and physical ecology and changes in these can shape goals, the use of cognitive artifacts and the use of other cognitive resources in agent environments that are not as purpose created and not as tightly coupled as environments of previous studies in this field.

Keywords: Cognitive ecology; distributed cognition; everyday life; older adults

Introduction

This paper elaborates on the notion of a cognitive ecology applied to the domain of older adults coping with cognitive problems and situations in everyday life. Examples from a cognitive ethnography of older adults will be analyzed. The reason for doing this is to shed some light on what a cognitive ecology can be in a social and physical environment that is not as tightly coupled or information dense as the cases where the concept of cognitive ecology have been used previously. By focusing on older adults I hope to understand how circumstances in everyday life can constrain, shape and alter the use of certain cognitive strategies that assist and therefore become important for the understanding of the cognitive process. This analysis will have a specific focus on ecology, as contrasted to the idea that the agent actively shapes the cognitive process. I believe this is important because it allows us to understand the role of the active agent more firmly in an environment that often is not as tightly structured, with a specific goal or purpose as a navigational bridge (Hutchins, 1995) or an early modern theatre (Tribble, 2011). First I turn to the concept of cognitive ecology and then I briefly turn to the tension between the idea that individuals contribute to the cognitive process and the idea that cognitive process are shaped by the circumstances. Finally several aspects of cognitive ecologies through the light of examples from the conducted cognitive ethnography are discussed.

Cognitive ecology

The understanding of cognition in relationship to environmental factors has now been a prominent undertaking in cognitive science for a while. The term "cognitive ecology" is now occasionally used to describe the study of cognition in context, emphasizing the general notion that cognition is something taking place and developing in an ecology that constrains, alters and forms cognitive processes (Hutchins, 2010a; Tribble & Sutton, 2011; Tribble, 2011). Tribble (2011, p.151) held that the idea of distributed cognition and the approach of cognitive ecology are basically the same. I will not here assess this statement, but in this paper I view it as a continuum between what can be seen as a distributed cognitive process and what formed, constrained, or altered this process. In this paper I want to focus on the latter aspect. "Cognitive ecology" has mostly been used in the field of animal cognition where the focus is on how the ecology shapes intracranial cognitive process (Dukas & Ratcliffe, 2009). In this paper I use the term cognitive ecology to explain something that also shapes processes that incorporates both intracranial and extracranial resources.

Hutchins (2010a) notes that cognitive ecology both can be viewed from a *synchronic* perspective (that is functional relationships in the present), and a *diachronic* perspective (that is cognition as development of cognitive ecologies). Much of the research into this field has focused on what goes on in the present without saying much about the developmental aspect of the cognitive process or mediated action (Sutton, Harris, Keil, & Barnier, 2010; Wertsch, 1998). This difference is important because what can constrain the use of resources is not always found in the present, "on the spot" (Hutchins, 2010b). We live and are shaped by cultural practices that to some extent determine the ways we "do things". Clark (2008) also emphasizes the understanding of interaction between different systems and specifically the continuous reciprocal causation between these systems. A key foundation for these related principles is the understanding of *how* the processes of constraining, altering and forming cognitive processes occur. For instance, why does someone use a particular artifact in a certain way? The answer can be found outside the individual and the specifics of the artifact.

Cognitive ecology suggests a unit of analysis that focuses on "units defined in terms of dynamic patterns of correlation across elements" (Hutchins, 2010a, p.705). What the correct unit of analysis should be to explain cognitive phenomenon is therefore not given before we have some understanding of the synchronic and diachronic ecology of where the phenomenon takes place.

Tribble (2011) used an ecological approach when she studied and historically analyzed theatre practices in the English renaissance theatre. The objective for her analysis was to explain the impressive performance of individuals

performing up to six different plays in a week with irregular and limited practicing time. One explanation of such a fact could easily be that these people had amazing memory abilities. But she proposed a larger dynamical model of this memory performance where it is important to understand the ecological differences that exist between theatre practices today and theatre practice back then. Back then "much preparation was individual, facilitated by the individual parts containing only the character's lines and his cues." (p.14). Much of this success was also facilitated by the ecological niche of the physical and social environment, where for instance parts were written to suit less experienced actors.

In her analysis she introduces the term "cognitive thrift", which is a principle that suggests that in a highly cognitively demanding environment, such as the theatre in this era, "every incentive would have been to minimize any additional cognitive burdens" (Tribble, 2011, p.32). In her conclusion she notes that cognitive ecologies "place more or less weight in internal mechanisms, on central control, or on particular forms of cognitive artifacts and social systems" (p.153). It can be argued that doing comparative studies of cognitive ecologies allow cognitive scientists to understand the relative contribution of different parts of a system to uphold reasonable performance.

In the case of healthy older adults coping with everyday life, it is not as easy to say that this is a highly cognitively demanding environment. Older adults cope well with everyday life in comparison with their performance in lab-settings, and one suggested explanation of this is that older adults seldom need to perform at their cognitive maximum in their normal life (Salthouse, 2012). How something as a cognitive ecology works in a setting where performance in a specific way is not often as demanding is to my knowledge rather unexplored. A term such as "cognitive thrift" might not apply in this context. This is because when we talk about cognitive ecology and distributed cognition we often do so in the domain of so called *cognitively rich environments* where a slight change in the ecology can profoundly shape the process and the performance.

The question that follows is what a cognitively rich environment is? In the case of early modern theatre or on a navigational bridge it can be interpreted as a measure of how much information that flow across various media, which directly relates to the problem at hand. How densely does the information flow across the various (tightly coupled) media to solve problems in everyday life is for me still an open question. Neither can we easily say that the environments and processes that take place within these environments of everyday life are task specific since these environments often have multiple purposes. How a cognitive ecology can form, constrain and alter cognitive processes and to some extent predict (according to some measure) successful performance in the lives of older adults would not necessarily be based on the same principles as in the highly demanding environments.

The ecology as opposed to the active individual

As noted above, one point made by Tribble (2011) is that even though memory demands were high in the early modern theatre practices, much of this taxing work was not solely placed on individual cognitive abilities. Much of this pressure was left to various aspects of the overall physical and social system of the theatre in work. The tension between the idea of an active individual and a shaping society or environment has been around for some time in various scientific fields (Wertsch, 1998). In cognitive science many have argued that too much emphasis has been put on the individual, placing to many cognitive abilities simply inside the skull as default (c.f. Hutchins, 1995). Wertsch (1998) argues that this is a question without an obvious answer since answers to this question are often not based on empirical grounds. In this paper I use one side of this dichotomy, the circumstances that shape, as an analytical tool to understand important aspects of the process.

Wertsch (1998), by adopting the "pentad" proposed by Burke (1969), uses a further elaborate analytical tool in his focus on mediated action as the unit of analysis. The pentad consists of *act*, *scene*, *agent*, *agency*, *purpose*, or in Wertsch:s words "What? Where? Who? How? and Why?" (p.13). The point is not that these are true reflections of reality; it is rather that they are tools for the interpretation of reality. Focusing on mediated action can be understood as emphasizing certain parts of the pentad and de-emphasizing other parts. The scene is for instance not included much in an analysis of mediated actions (Wertsch, 1998). But on the other hand Wertsch argues that focusing on mediated action allows us to be in the middle of an individual and collective/distributed perspective. The agent and her mediational tools (see cognitive tools) are irreducible to each other in terms of the action. In my examples below I will use the idea of a scene as something that realizes and in a true sense constrains and alters the cognitive process in certain directions and therefore also sometimes alters the mediated action. The scene is here part of the cognitive ecology that Tribble uses in her analysis.

Wertsch (1998) also focuses on the fact that mediational tools have often been developed for other purposes than the reasons they are used for in the present. Therefore he emphasizes investigation of both *consumption* of mediational means and *production* of mediational means. Regarding the production of mediational tools he notes that tools are often borrowed from other sociocultural contexts and that the processes of what he calls a *spin-off* of actions with certain mediational tools are not always developed from a clear purpose of an inventor.

Even if we in this description find the notion of an agent that borrows and produce mediational tools, the idea of the pentad suggests that we can analyze what is not physically part of the agent and the tool and say something about how the agent and her mediational tools became orchestrated in an action or in a distributed cognitive process.

The role of the individual can theoretically be pictured as a continuum from a top-down driven agent to a bottom-driven agent to factors that stand outside the role of the agent but still support the cognitive process. Clark (2006) talks about ecological control as something we do when we do not micromanage every point in the process but still search for opportunities. When we do not micromanage the process, much of what constrain the process is outside the individual's scope of control. Certain processes have been developed to suit certain ecologies. To illustrate this I now turn to cases from a conducted cognitive ethnography of elderly people.

Ethnography of everyday life

Previous research in cognitive aging suggests that older adults actually do have an active role in their compensatory practices for declining memory abilities (c. f. Frias, Dixon, & Bäckman, 2003). Through self-reports older adults often report that they adopt external memory aids and cooperation with social others (c. f. Cavanaugh, Grady, & Perlmutter, 1983; Frias et al., 2003). With such premises, even though they are based on self-reports, it is worth asking to what extent such a wide unit of analysis as cognitive ecology is applicable and at all important in these kinds of less problem-centered environments.

The material referred to below was collected as part of a cognitive ethnography during the summer of 2010. The scenery of this is in the home healthcare system where I worked as a healthcare assistant. Within this context I conducted interviews outside the role as an assistant, and observation in the role as an assistant. Most of the participants had normal cognitive functioning for their age and some had diagnosed memory declines. The specifics for each case are provided with the examples (but for more information see Dahlbäck, Kristiansson, and Stjernberg, 2013).

The following sections are categorized according to conclusions I can draw from the specific examples presented, together with the overall material collected in relationship to earlier theorizing in cognitive ecology (Hutchins, 2010a; Tribble, 2011) and earlier presented ideas of Wertsch (1998).

First I consider the general case that environmental factors together can enact certain cognitive processes. Second I relate cognitive ecologies of everyday life in relationship to the use of cognitive artifacts. Third I discuss the social nature of everyday life and how these social circumstances form cognitive processes. Fourth I note that the ecology can form the goal of cognitive processes and last I discuss how we can understand diachronic processes by understanding how ecologies shape cognitive processes.

Environmental factors enact the nature of cognitive processes

A is 91 years old with a normal cognitive decline for his age. He has problems with hearing and particularly seeing. (All examples in this paper are verbatim translations from Swedish from my original field notes.)

"He tells me that he goes to the grocery store almost every day: "there is always something you need and there is also a seating arrangement where there is always someone you know from previous work places". […] When I ask him if he writes shopping lists he says that he doesn't and that he remembers everything in his head. He pictures how he usually goes through the important places in his home before he goes to the store, checking whether something is missing." (Excerpt from A)

His troubles with seeing were apparent at other times during this interview. The case notes how processes of remembering can be (a) constrained, in this case by his seeing impairment, (b) altered, by the fact that he lives rather close by the grocery store and (c) motivated by the fact that going to the store (almost) every day also has a social incentive. If his cognitive ecology would have been different in terms of social network, physical surrounding and limitations, his processes of remembering could have been distributed differently.

A is also aided by his routine of going through the usual places in his home where things often are missing. By doing this he provides himself with a mental anchor for remembering what was missing at the particular places at home. Partly because he more likely can recall what he found missing, but also because certain places constrain what he can possibly need. In a sense he has invented the method of loci himself. This together with the fact that he goes to the store almost every day makes his process of purchasing groceries a resilient one (c. f. Hollnagel, Woods, & Leveson, 2006). His strategy works rather well in this specific ecology.

Doing ethnography in the context of the home healthcare services creates a special kind of cognitive ecology. This is because the ethnographer is in many cases part of the cognitive process. Since distributed cognition emphasizes the social aspect of cognition being participatory shapes the phenomenon that we try to investigate. Consider the next entry.

"*A large part to achieve the smoothest possible performance is to know by heart what routines apply to what person. Of course there is a general routine of logging into the system, saying hi etc. […] But to do it as smoothly as possible you need to know what the home environment looks like and the viewpoint of this service from the perspective of the person. Where should the socks hang? Where is the medicine locker? How do you prepare a sandwich in the correct way?* (Excerpt from B)

This case is also a about the order of doing things. The smoothest possible performance is about coordinating work and to together remember what to do where, in what order, when. "*She didn't recognize me because it was the first time I was there. She started pointing at the medicine locker and asked if I had the keys. […] When I told her that I had the keys she rose and walked to the other room, apparently to*

let me take off the socks before taking the medicine". (Excerpt from B)

Notice how the information of me having the keys initiates a more complex routine where the medicine is not the first goal of the routine. Even if this entry is also about how the work environment taxes the cognitive processes of the worker it also highlights an interesting cognitive ecology where it is important that all actors have a somewhat similar picture of how the activity should develop. If this shared picture is not the case this is indeed a cognitively demanding situation for both parts. But here the ecology of the home healthcare services provides with some structure regarding the predetermined goals of the assistance that the assistant know and can use to adapt to the circumstances of the visit. The receiver also adapts and initiates question, but overall the situation in the case above is cognitively taxing since the ecology is not as when the more experienced workers arrive.

In the case of B (as perhaps opposed to A) the practice between a home healthcare assistant and the healthcare receiver is a rather predefined practice with certain goals, which have been established over several iterations of the service across several assistants. The receiver has adopted a general routine that works in the ecology of this service, a kind of a "cognitive thrift". The routinized coordinated practice is in this sense more equal to how the cognitive ecology is shaping the cognitive processes on a navigational bridge or in a theatre.

How the cognitive ecology can shape the roles of artifacts

The case of C below shows something similar to the case of the home healthcare setting above, but this case also shows how the role of a cognitive artifact, in this case a shopping list, are given an unspecified or a degraded role when used in a new cognitive ecology. This entry is from the first time she receives shopping assistance due to a physical problem.

"*C uses a shopping list for the shopping session. She makes it clear that it is important for her that she remembers paracetamol as she has none at home and is in some pain. She constantly consults the shopping list to remind herself where to go. In the end, we cannot find paracetamol. I am not used to this supermarket, so I am of no help. She stops and asks a worker, who tells her that it is to be found after the check-out. She wants me to remind her if she forgets. After the check-out she has indeed forgotten, so I remind her*." (Excerpt from C)

From the perspective of Wertsch (1998) the mediated remembering through this shopping list has been transformed to a mediated remembering both through the shopping list and a social other. Using the perspective of a cognitive ecology makes it possible to predict that we need to view this activity from different units of analysis. Information is propagated mostly between the subject and her shopping list and also between the subject and her assistant; but also to a lesser degree between the assistant and C:s shopping list. The idea that artifacts exist with a functional relationship to their ecology has also been noted by Garbis (2002) that studied a tightly coupled cooperative process management setting. Remember that the task described above as defined through the home healthcare service was not about remembering things, it was about the physical challenge grocery shopping entails. But nevertheless the activity provides a certain kind of cognitive ecology that provides certain kinds of resources, that in this case inevitably creates a kind of process.

It is possible to view this process from two perspectives. One is that the individual must be active in this process, choosing resources and utilizing the resources sufficiently to perform reasonable good. The other, as noted, is to emphasize the circumstances that give rise to the role and utilization of resources.

"D has memory problems and cannot always remember whether the home healthcare personnel have been on their visit to her, so she keeps the used time and day-specific plastic medicine envelope on her kitchen table after it has been used as a way of helping her to assure herself that they have been there that day. For this visit, she comes running after me as I am about to throw away the plastic envelope in the bin." (Excerpt from D)

The case is that this envelope has information so that it works as memory trace of previous activities. In this case it is worth noting, despite her memory problems, the active role of D to achieve good performance (Dahlbäck et al., 2013). She takes a cognitive artifact developed for one purpose and uses it in a different context for a different purpose (compare Wertsch, 1998).

But again this is also in a relationship to the cognitive ecology and how it realizes the use of an artifact in an efficient way. The experienced and the inexperienced home healthcare worker create different cognitive ecologies taxing mental resources of parts of the system differently. Under normal circumstances this cognitive system is a rather stable one. On the other hand part of the normal cognitive ecology is that there are different agents in operation creating a normal variation in the system. Another thing about the ecology in this case that is worth noting is that she comes running when she *hears* me throwing away the plastic envelope. She lives in a relatively small apartment and can therefore not be too far away from the action taking place. In this case she hears a sound from the bin that usually is not there. The artifacts in the cases of C and D have certain existences due to ecological factors.

The social happenstance

I have already talked about the understanding of the cognitive process in the home healthcare services as a special kind of ethnography since the ethnographer is literally part of the cognitive process. In cases when people have a pronounced cognitive decline, that idea is not very strange since they are in the home healthcare system for that reason. But most of the time (at least in this specific unit) people are not in the home healthcare system because of

cognitive problems, but for a variety of physical problems. The point is that much of what in specific situations has formed the cognitive process is not always part of the cognitive process, but can be considered part of the cognitive ecology.

Consider the case of E, who each morning calls a few of her sisters to simply update the status of their lives. The fact that this happens each day tells us that they are rather good at keeping track of each other. The routine gives an arena for distributed processes of remembering. The fact that they are calling each other each morning and having a social environment that allows for such communication is part of their cognitive ecology. This is a kind of cognitive arena since it likely shapes the nature of the communication, which in turn shapes the distributed processes as they arise.

In a similar way we could view the case of C. In an interview with A I asked him in relation to his seeing problems what happens when they re-arrange in the grocery store, whereupon he quickly answers that "there is always someone that you can ask about the location of things". In the future detailed studies of situations where the social arena works as a resource can be of importance if we want to understand how individuals utilize this arena sufficiently.

The smoothest possible performance

Part of understanding the ecology of cognitive phenomenon is to understand what a reasonable performance is for the particular subject or group. In the English Renaissance theatre it was the "smoothest possible performance" and not necessarily perfect recall (Tribble, 2011). In the case of A above it is possible that the smoothest possible performance is not to perfectly recall all the groceries needed each day. For A, depending on the importance of the grocery, forgetting to buy something one day includes a new possibility to remember to purchase it the next day. A process-oriented view on memory de-emphasizes the product of what to remember. To understand how humans remember we need to look on the process of remembering (c. f. Dixon, 1999). One important aspect of this is that this is from the perspective of the scientist conducting her research. The product from the subjective perspective in real-life settings can in a very true sense be the most important aspect. Consider the case of E.

"E has an appointment at the podiatrist. She has a note from the podiatrist which she has posted on her fridge. She has turned the note around and written the date again, though bigger this time. She has also noted this in her calendar, located on the kitchen table. This calendar is always located on the kitchen table. For some unknown reason, the dates have gotten mixed up, and the wrong date has been transferred to her calendar." (Excerpt from E)

This is an interesting example since it shows the usage of different external sources for the same information. We can note that remembering appointments can be considered a highly important task to perform perfectly on since it is maneuvered with so many different resources. The smoothest possible performance is in this case, as in contrast to the grocery shopping, perfect recall. The point here, similar to what Tribble (2011) noted, is that the social and cultural environment to some extent determines what "the smoothest possible performance" is. This is also an example of how the understanding of the mediated action gives insight to the nature of the purpose of the action (Wertsch, 1998).

Consider once again the case of A. What would happen if A would have a longer way to the grocery store? An apparent consequence would be that A:s physical limitations would be strained and therefore he may decide to not go to the store at all. But imagine that he still would manage despite the larger physical demand, and perhaps decide to walk there every second day. Would not his cognitive processes be composed in a different way? It would at least change what the smoothest possible performance would be. If one had a long road to the grocery store one would not as likely want to forget to buy something. Further, if the goal of the activity changes, the process will likely also change. Perhaps his loci-inspired remembering would be backed up with a shopping list despite his problems with seeing. This is of course an imagined world, but not an unlikely world.

Cues of a diachronic process

As previously mentioned, an understudied part of cognitive ecologies is the diachronic perspective; that is how cognitive processes develop over time. The discussion of B shows how the study of the ecology can give insight into how cognitive processes develop. If one aspect of the ecology changes the process may also do so. Consider the next case of E:

"*E demonstrates how to clean spoons discoloured by tea with the help of baking powder. E stands by the sink while the daughter and I are sitting by the kitchen table. […] The daughter notices that A uses the wet spoon in the powder container: "you can't do that, it will ferment". E answers quickly, and suggests that it will not ferment and will not be used for baking: "yes I can, because it is old baking powder". When E returns the container to the cupboard, the daughter remarks that she shouldn't place it next to the active baking powder. E rebels against her daughter's suggestion and places it next to the active container. She stops for a moment and lifts it a couple of times and says that she will anyway pay attention to and remember by the weight that it is the right one. The daughter remarks that at some point the containers will be of the same weight and they will be indistinguishable. E adds that anyway she always tests if the powder is active before baking.*"

We can view this from the perspective of cultural practice. E has learned to clean spoons in this way and (at least she claims) incorporated that knowledge into another activity, baking. She does not need an external memory aid to find the correct active baking powder. She instead remembers the practice of testing the powder, which appears to work instead of the daughter's suggested strategy. Understanding the practices of a group can predict development of cognitive strategies over time. Certain

ecologies of practices shape certain needs to develop certain kinds of cognitive processes. In the case of E a cognitive process is used that can resist the process of cognitive aging rather efficiently.

Previously I have also discussed examples where we can predict that changes in cognitive ecologies such as suddenly being part of the home healthcare system constrain and alter the cognitive processes. Changing the social circumstances in general such as giving more structure or expectation of certain activities changes the cognitive processes involved, such as the use of an artifact for some purpose. The case of D previously is likely the clearest example of this, where the role of the envelope as an artifact is given two functions to serve different components of the activity. Understanding changes and ecological factors in people's lives can help us understand the diachronic aspect of cognitive processes and possibly also predict cognitive performance in new ecologies.

Concluding remarks

Still there is a need to understand what the differences are between kinds of ecologies and what principles are at work in the shaping processes of cognitive processes in everyday life. It is still rather unexplored how distributed cognitive processes work in a less clear purpose-driven environment, in a less information dense environment, that are guided by a more or less clear socially structured environment, and that are more or less demanding for individuals. The importance of having a cognitive process adapted to the cognitive ecology can be different between these environments. It can be that the role of the individual is far more important in everyday life situations, and that the role of the ecology is more subtle in these environments since it is an ecology that do not shape, alter or constrain the cognitive process *as much* as other ecologies.

I have used the case of older adults to show that cognitive ecology is a useful term to understand cognitive processes in everyday life. But I do not believe that the points made throughout the second half of the paper are specific to older adults. Older adults are an interesting group for many reasons. One is that they have been investigated quite thoroughly in lab-settings and that we know that the prediction of lab-performance to the settings of their everyday life is low. Cognitive ecology is one way to understand this. But we all live in an everyday life where the social network and the length to the grocery store to some extent shape our cognitive processes. This paper shows that the ecology can shape how much effort we put into our cognitive processes, how we distribute them and how we create routines for them in everyday life environments.

Acknowledgements

I thank Nils Dahlbäck, Fredrik Stjernberg and two anonymous reviewers for helpful feedback on a previous version of this paper.

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