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Learning and selection

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Abstract Are learning processes selection processes? This paper takes a slightly modified version of the account of selection presented in Hull et al. (Behav Brain Sci 24:511–527, 2001) and asks whether it applies to learning processes. The answer is that although some learning processes are selectional, many are not. This has consequences for teleological theories of mental content. According to these theories, mental states have content in virtue of having proper functions, and they have proper functions in virtue of being the products of selection processes. For some mental states, it is plausible that the relevant selection process is natural selection, but there are many for which it is not plausible. One response to this (due to David Papineau) is to suggest that the learning processes by which we acquire non-innate mental states are selection processes and can therefore confer proper functions on mental states. This paper considers two ways in which this response could be elaborated, and argues that neither of them succeed: the teleosemanticist cannot rely on the claim that learning processes are selection processes in order to justify the attribution of proper functions to beliefs.

Keywords Selection process · Teleosemantics · Theory of content

Introduction

Teleosemanticists claim that beliefs have content because they have proper functions of a particular kind, and that they have proper functions in virtue of being the products of selection processes.[1] But what selection processes? Some beliefs, or

[1] See for example (Papineau 1987, p. 65) "When we talk of some characteristic C being present *in order* to produce E, we should understand ourselves to be claiming that C is now present because of some past selection process that favoured C because it produced E."

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some tendencies to form certain beliefs under certain circumstances, are presumably the products of *natural* selection. When a dog suddenly growls nearby, I form a belief that causes me to prepare to flee. Presumably it is as a result of natural selection that I have the tendency to form that belief under those circumstances. My ancestors had that tendency, and it helped them to survive and reproduce: those contemporaries of my ancestors who did not have it were more likely to get eaten.

However, there are many beliefs about which such an evolutionary story is completely implausible. The most striking cases are novel beliefs—beliefs about new or newly-discovered things such as jaffas and protons. The tendency to token the belief "This is a jaffa" when eating one cannot be a direct product of natural selection.

In response to the problem of how such beliefs can have proper functions, Ruth Millikan argues that beliefs have *derived* proper functions—belief-producing mechanisms have proper functions because they were naturally selected for, and beliefs themselves have functions derived from the functions of the mechanisms that produce them.[2] In contrast, David Papineau argues that learning processes are selection processes too, and that therefore learned beliefs can have direct proper functions.[3]

The latter response has a certain immediate appeal. Selection processes confer proper functions on their products; mental states (by teleosemantic hypothesis) have proper functions; there is a selectionist strand in the psychological literature on belief and concept acquisition; the competing Millikanian hypothesis is complex: consequently the hypothesis that mental states have proper functions because mental states are acquired via selection processes seems worth taking seriously. However, the hypothesis has never been properly evaluated, at least in part because it has never been spelled out in any detail.

This paper elaborates the hypothesis that learning processes are selection processes and considers whether or not it is plausible. The section "What is a selection process?" is a discussion of the nature of selection processes: the section "Are learning processes selection process?" considers whether or not processes of belief-acquisition and concept-acquisition qualify as selection processes. The verdict is that although some processes of belief-acquisition may be selectional, many are not, and that there is considerable reason to doubt that processes of concept acquisition are selection processes either. Finally, the section "Where does this leave the teleosemanticist?" explores the consequences of all this for teleosemantics: I argue that even if processes of concept acquisition did turn out to be selectional, that would not be enough to ground the attribution of proper functions to beliefs. The conclusion is that the teleosemanticist cannot solve the problem of ascribing content to non-innate beliefs by appealing to the idea that learning processes are selection processes.

What is a selection process?

There are a number of things one might mean by "selection process." The kind of process that is of interest here is the kind that confers proper functions on its

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[2] See (Millikan 1984, pp. 41–43).

[3] See Papineau (1987, pp. 65–67; 1993, p. 59).

products. The proper function of something is what that thing is *for:* what it is supposed to do. My heart has the proper function of pumping blood: my can-opener has the proper function of opening cans.[4] Natural selection is the paradigm example of a selection process that confers proper functions. Other than things that are *designed* for some purpose, the things that we most naturally describe as having a function are biological items like hearts, eyes and lungs.

Not everything something does is its proper function. Computer monitors can be used as door-stops, but that is not what they are for. My heart makes certain noises, but making those noises is not its proper function—my heart is for pumping blood.

An item may not perform its proper function: for example, most sperm do not succeed in fertilizing an ovum. Furthermore, an item may not even have the capacity to perform its proper function: a heart so deformed that it cannot pump blood still has the function of pumping blood.

Consequently for any X, we cannot answer the question "What is the proper function of X?" simply by talking about what X does or what X has a propensity to do. We cannot even answer it by talking about what *useful* things X does: X may do something useful by accident, as when the Bible in the soldier's breast-pocket stops the bullet and saves his life, in which case that is not its proper function. If X is an artifact, we might answer the question by talking about what X was designed to do, as opposed to what it fortuitously happens to do. But unless we are creationists, we cannot take this line in talking about the proper function of the heart or the lungs or (supposing that beliefs have proper functions) the belief that it is raining.

The prevailing analysis of the proper functions of biological items is in terms of natural selection. Here is Karen Neander's version of it:

> It is the/a proper function of an item (X) of an organism (O) to do that which items of X's type did to contribute to the inclusive fitness of O's ancestors, and which caused the genotype, of which X is the phenotypic expression, to be selected by natural selection. (Neander 1991a, p. 74)

It is likely that pumping blood particularly well or efficiently is what the hearts of my ancestors did which helped my ancestors out-reproduce those of their conspecifics who did not have such efficient blood-pumps. The function of *my* heart is therefore to pump blood.

In order to generalize this account so that it covers the proper functions of items that are not the direct products of natural selection, we need a general characterization of selection processes. There is reason to want such a general characterization quite independently of any interest in teleosemantics. There are a number of examples of function-conferring processes which have many characteristics in common with natural selection: for example, the process by which antibody-producing cells proliferate differentially in response to the presence of a virus (see Darden and Cain 1989; Piatelli-Palmarini 1989; Hull et al. 2001) and processes by which artefacts acquire functions independent of the intentions of their

[4] The term "proper function" was coined by Millikan (1984). There are other kinds of function, but in this paper "function" can be taken to mean "proper function," since proper functions are the only kind I am concerned with here.

designer or creator. A general account of selection processes which covered these cases as well as natural selection would be of great interest.

David Hull, Rodney Langman and Sigrid Glenn provide such a general characterization in "A general account of selection: Biology, immunology, and behavior," 2001. I shall modify their account slightly, and use the modified version in considering whether learning processes are selection processes. According to Hull et al., a selection process consists of:

> repeated cycles of replication, variation and environmental interaction so structured that environmental interaction causes replication to be differential. The net effect is the evolution of the lineages produced by this process. (513)

As Hull et al. point out, this characterization of selection processes needs careful explication.

Variation is necessary for selection: without it, there would be no alternatives to be selected between. And *environmental interaction* is necessary: variations between items must cause differences in their interactions with their environment such that some of them will be more successful at replicating themselves than others.

Some kind of *copying* or *reproduction* or *replication* is necessary for selection. Here it is important to distinguish selection processes, which are iterated processes that confer proper functions, from one-shot sorting processes that do not. Imagine a population of non-reproducing individuals that vary in ways that matter to how long each one survives. Suppose they are rocks on a beach varying with respect to their hardness, and that how long a rock survives before being turned into sand by the action of the waves depends (in part) on the hardness of that rock. This is a sorting process: over time, environmental conditions sort the harder rocks from the others. But it is not a selection process in the sense we are considering here. Neither does it confer proper functions. We are not inclined to say that the hardness of a rock is *for* enabling the rock to survive the action of the waves, or that the rock is hard *in order to* enable it to survive the action of the waves—the hardness of the rock is not *for* anything at all. The reason is that in this case there are no iterated cycles of replication. If rocks reproduced, and if surviving longer as a result of their hardness enabled them to reproduce more successfully, and if hardness were a heritable characteristic of rocks, then it would make sense to say that the hardness of a current rock had a proper function. There would be a selectional explanation of its hardness in terms of how hardness had enabled its ancestors to reproduce more successfully than other rocks. In the absence of cycles of replication, however, no such explanation is available. In the case of a one-shot sorting process, there is no lineage about which we could say that the later items in the lineage have the characteristics they do because of the ways in which those characteristics increased the reproductive success of the earlier items in the lineage.

There remains the question of what counts as replication, and indeed whether or not replication is a concept that should be appealed to in the characterization of selection processes. As the term is standardly used, replication requires a very high degree of fidelity of copying, whereas all that is required for a selection process is some kind of inheritance across generations (see Godfrey-Smith 2001, p. 538).

What we need is an account of the conditions under which an item counts as a copy of, or a descendant of, or a member of the same lineage as another item. We have a good enough handle on this for the case of evolution by natural selection, but we do not have the general account of what I shall call “copying” that is required for a general characterization of selection processes. If we are considering whether a particular instance of a pigeon pecking a button is in any interesting sense a descendant or copy of an earlier pecking of that button by that pigeon, or whether a particular tokening of a belief is a copy of an earlier tokening of that belief, we need a specification of the conditions under which an item counts as a copy of or a descendant of another item.

As Godfrey-Smith (2001, p. 538) says, all that is required is “a systematic correlation between parent and offspring.” However, for this to be useful in the characterization of selection processes in general, we need to specify what count as “parents” and “offspring” when we use those terms outside of the biological domain in which their meaning is obvious.

I do not propose a complete analysis of the generalized copy/descendant relation here. Rather, I will provisionally adopt the following intuitively plausible set of necessary conditions, which I take to be a first step towards such an analysis.

If B is a copy or descendant of A then:

(1) A and B have some properties in common
(2) A causes B to come into existence
(3) For some of the properties A and B have in common, it is the case that if A had not had those properties, B would not have them.

These conditions are too general to be jointly *sufficient* for B’s being a copy or descendant of A. Suppose the food I ate last week gave me the energy to acquire food this week: what is in my digestive tract this week (B) is not a copy of what was in it last week (A), although all of conditions 1–3 are satisfied.[5] However, in any case in which one or more of these conditions is *not* satisfied, B is not a copy or descendant of A.

In the sections which follow, I consider which (if any) learning processes are selection processes. I will use the Hull et al. characterization of selection processes, but with one modification; I allow lower-fidelity copying than is suggested by their use of the term “replication.”

Are learning processes selection processes?

David Papineau appeals to the idea that learning processes are selection processes in order to explain how it is that non-innate beliefs can have proper functions (Papineau 1993, p. 59). There are two ways in which the idea that learning processes are selection processes might be spelled out, either of which might be thought to ground the ascription of proper functions to beliefs.

[5] The example is appropriated, with thanks, from an anonymous referee for *Biology and Philosophy*.

(1) Belief-acquisition is a selection process and therefore beliefs have proper functions.
(2) Belief-acquisition is not a selection process but concept-acquisition is. Concepts have proper functions because they are the products of a selection process, and beliefs have proper functions because they are composed of concepts.

I am not concerned about which of these Papineau would defend: some of his statements about learning and selection suggest the first and others the second. Rather, my interest is in whether either of them can succeed as a strategy for ascribing functions and therefore content to non-innate beliefs.

I first consider operant conditioning, which is the kind of learning that looks most like a selection process. I then consider processes of belief acquisition in general and whether they are selectional, and then what concept acquisition processes would have to be like if they were to be selectional.

Operant conditioning

If you put a pigeon in a box in which there are a range of objects with which it can interact, including a button that when pecked causes pigeon food to appear, the pigeon initially performs a wide range of behaviours, accidentally acquiring food occasionally when it happens to peck the button. Gradually the frequency with which the pigeon pecks the button increases. The pigeon learns that pecking the button gets it food and so does it more often.

Here, the items that appear to differentially replicate are behaviours. The pigeon displays a range of different behaviours: button-pecking, floor scratching, and so on. Interactions with the environment cause some of these behaviours to be repeated with increasing frequency while others are not. Because of the way the environment is set up, button-peckings get the pigeon food and other behaviours do not, so button-pecking behaviour proliferates and other behaviours decrease in frequency. Operant conditioning seems to fit the criteria for being a selection process: there are "repeated cycles of replication, variation and environmental interaction so structured that environmental interaction causes replication to be differential."[6]

David Papineau gives only one example of a human learning process which he takes to be selectional, and as described by him, it sounds like an operant conditioning process. A child, Papineau thinks, gets positive feedback when he has a belief that leads him to say something approximating "blue" when pointing at things that are blue. Thus the tendency to token beliefs that lead to the utterance of "blue" in the presence of blue things gets "fixed," while the tendency to token beliefs that lead to the utterance of (for example) "red" in those situations is lost (Papineau 1987, p. 67). This sounds a lot like the process the pigeon goes through.

[6] For more detail on operant conditioning as a selection process, see Hull et al. 2001, pp. 521–526.

What is the belief (or the belief/circumstance pair) that allegedly gets reinforced in this case? You might think that it is a belief about the colour of something—the belief that the object in front of the child is blue—or more precisely the tendency to token that belief when the object in front of the child is in fact blue. But this cannot be right, because children develop the ability to categorize things by colour much too early. Children have colour concepts long before they have words for them and long before they can understand other people's words for them. (See Bornstein 1985, pp. 121–123.) Presumably children form beliefs about which objects belong to which colour categories before there is any reinforcement (at least of the kind Papineau discusses) for having them—the ability of a 4-month-old infant to distinguish colours does not have any effects that will enable people to give the appropriate feedback. The Papineau story is a hypothesis about what happens later, when the child acquires the rudiments of speech.

The belief in question, then, must be a different one: the belief that "blue" (the utterance) means blueness (the property), or that "blue" (the utterance) expresses <blue> (the concept). The belief allegedly reinforced must be a belief about language.

This story about the acquisition of the vocabulary of a first language has some initial plausibility. A child learning a new word does appear to utter it every time it comes into his head that the object he is looking at is one that the word applies to, and often, parents smile and say "Yes, it's blue" every time the child gets it right. However, the conditioning model of vocabulary- acquisition was thoroughly discredited by Chomsky (1959) in his review of B.F. Skinner's *Verbal Behavior* (along with, more famously, the parallel model of grammar-acquisition). Although parents often provide the kind of feedback Papineau suggests, children do not need it—they accquire the vocabulary of their first language perfectly well without it, unless you lock them in a cupboard and never talk to them at all. Operant conditioning may well be a selection process. But Papineau's putative example of learning as a selection process is not convincing, and it is the only example he provides.

Is belief acquisition a selection process?

Even if language-acquisition is not a selection process, belief-acquisition in general might be. Let's look first at an example of the kind of belief-acquisition that looks on the face of it most like a selection process; trial and error learning.

Suppose I learn, in the course of 5 years, how to grow good tomatoes in my garden. The method is to increase the acidity of the soil and also add nutrients, and plant tomato seedlings of Variety A. In the process of discovering this, I try out numerous other possibilities. I try leaving the soil untreated, I try increasing the acidity of the soil but not adding nutrients. I try other tomato varieties.

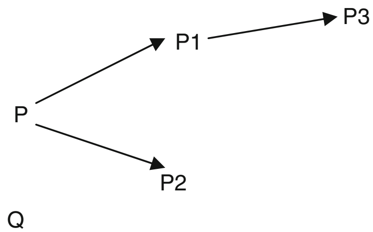
Suppose that each of my actions is based on a hypothesis about what will produce good tomatoes.

P = Variety A will thrive in the initial condition of the garden
Q = Variety B will thrive in the initial condition of the garden

P1 = A will thrive if the acidity of the soil is increased
P2 = A will thrive if the acidity of the soil is decreased
P3 = A will thrive if the acidity is increased and nutrients are added

The hypothesis I end up believing is P3. P3 is a member (the last member) of a lineage of hypotheses: it is a modification of P1, which in turn is a modification of P.

Let's set the example up to look as much as possible like a selection process. Suppose that first I planted a couple of varieties of seedlings, A and B, and did not add anything to the soil. Then I abandoned the variety that did less well, Variety B: hypothesis Q had no descendant hypotheses. Variety A did better, but not well enough: hypothesis P generated two modifications, P1 and P2, which I tested in different parts of the garden. Decreasing the acidity made the plants grow less well: hypothesis P2 was abandoned and had no descendants. Increasing the acidity improved the tomatoes, although not enough: P1 was modified to P3, and when no disconfirming evidence emerged over several trials, P3 became a belief.



This is a simplified example. There could be more varieties, and there could be more stages in the sequence. But at some point, since we are talking about a process of belief formation, some hypothesis must turn into a belief. And, if it is to look at all like a selection process, at each point acting on a hypothesis must have some positive outcome if that hypothesis is to be modified rather than abandoned. (There are lots of ways the learning process might go which would not satisfy this constraint. I might perfectly sensibly think that the fact that Variety A does better than Variety B in untreated soil is not a reason to think that it will do better in treated soil, in which case Hypothesis Q might have descendants parallel to those of Hypothesis P.)

Is the process described above a selection process? Recall that a selection process consists of "repeated cycles of replication, variation and environmental interaction so structured that environmental interaction causes replication to be differential" (Hull et al. 2001, p. 513). In the example described above, what is it that reproduces, interacts with the environment, and varies in ways which are heritable and which affect its environmental interactions and (consequently) its reproductive success? There are a number of possible candidates. The most obvious one is that it is hypotheses which reproduce (with modifications).

The idea that in this example we have a lineage of hypotheses, with P3 being a descendant of P1 which in turn is a descendant of P, seems consistent with our very general characterisation of the ancestor/descendant relation. P3 is like P1 in that both say that if some set of conditions obtain, then the tomato plants will thrive, and both include amongst the conditions various of the unspecified conditions initially prevailing in the garden (all of them except the acidity and nutrient content of the soil) modified by increasing the acidity of the soil. They differ in that P3 but not P1 includes among the conditions the addition of nutrients to the soil. At each point there is a population (in this simplified example an unrealistically small population) of varying hypotheses which interact with the environment by causing different behaviour in the gardener who is entertaining the hypotheses. The differences between the hypotheses cause the interactions with the environment to differ in ways which make a difference to the reproductive success of the hypotheses. P2 does not spawn any modified versions of itself—it is the end of its lineage—because it causes the gardener to decrease the acidity of the soil and the tomato plants do not thrive. P1, on the other hand, causes the gardener to increase the acidity, the plants do better, and P1 is modified to P3: P1 is more reproductively successful than P2. So far so good. At this point an oddity arises. P3 does not spawn any successor hypotheses, not because it is abandoned (like P2) but because, rather than being modified, it becomes a belief. It is not reproductively successful at all, since reproduction for a hypothesis involves spawning modified versions of oneself.

There are a number of possible responses to this. One is to deny that it is a problem. On this story, the belief that Variety A will thrive if the acidity is increased and nutrients are added is the product of a selection process, and there is no need to claim that once the belief is in place it is *maintained* by a selection process. However, P3 does not become a belief immediately it is entertained. Part of the process of belief formation by trial and error involves a hypothesis surviving the kind of tests that its ancestor hypotheses failed. But at this point in the process the hypothesis is not reproductively successful at all. It is doing well at *surviving*: but it is reproductive success rather than survival which is required for the process to be a selection process.

There are a couple of candidates other than hypotheses for the role of being the thing that reproduces and interacts with the environment in processes of trial and error learning. Neither of them runs into this particular problem: both of them continue to reproduce even after competing hypotheses have dropped out of the picture. The first candidate is behaviours; the second is what might be called occurrent beliefs or occurrent hypotheses—particular tokenings or callings to mind of a standing belief or a standing hypothesis. Perhaps each planting of seedlings of Variety A in treated soil is a descendant of the previous planting. Or perhaps what reproduces is the thing which presumably precedes each instance of that behaviour: the calling to mind of the standing hypothesis (or, later in the process, belief) that planting seedlings of Variety A in treated soil will produce good tomatoes.

There is an apparent problem with both of these suggestions. Instances of the behaviour, one might think, are not in fact copies of each other: one year's planting is not the cause of the next year's. Rather, they have a common cause, an inner state, the belief or hypothesis that planting in this way will produce good tomatoes (Note, however, that this will be true in the pigeon case as well, unless philosophical behaviorism is true of pigeons.). Likewise with occurrent beliefs or occurrent hypotheses: when, in the spring of 2007, I call to mind my standing belief that this is how to produce good tomatoes, that event is not a copy of 2006's calling to mind of the same belief. Rather, the two callings-to-mind have the same underlying cause. One red blood cell is not a descendant of an earlier red blood cell in virtue of having been produced later by the same bone marrow. Likewise, one might think, one occurrence of a belief is not a descendant of an earlier one in virtue of having been produced later by the same standing state.

However, recall how inclusive our characterisation of the ancestor/descendant relation is. Consider also a case which it seems clear should be covered by it: the case of biological organs, or phenotypic traits more generally. There is a sense in which my mother's heart and my heart are members of the same lineage, even though her heart did not directly cause mine to come into existence, even though this too could be seen as a case in which the two have a common cause.[7] This had better count as a case of the ancestor/descendant relation, since such traits are the paradigm case of things which have proper functions as a result of being produced by selection processes.

Consequently, pending a more precise characterisation of the ancestor/descendant relation, we should say that cases of trial and error learning such as the one described above *may* be selection processes. Note, however, how carefully you have to set up your example to make it plausible that it is an example of a selection process, and how difficult it is, even then, to make the case. Anyone who claims some process is a selection process needs to specify what it is, in that process, that reproduces and forms a lineage, and even given a very inclusive characterisation of reproduction, this may not be easily done.

Even if we grant that processes of trial and error learning are sometimes selection processes, many instances of belief acquisition do not involve trial and error learning, and do not even on the face of it appear to be selectional. Often we acquire information by being told things by reliable people or reading them in reputable books, rather than by entertaining a number of hypotheses until one turns out to be more useful than the others. Consider my acquisition of the belief that Paris is the capital of France. I perceived the sequence of symbols "Paris is the capital of France" on a page. On its way to storage in my long-term memory, some elements of my representation of it were discarded—the font, for example, and the colour of the type. What remains is a memory of the proposition expressed by the sentence, and perhaps also the memory that I found out that Paris is the capital of France while reading book X in place Y.

One difference between operant conditioning situations and this kind of human learning situation is the lack of immediate pay-off in most human learning situations. Much human learning seems to be a process of gathering information about the environment without any short-term benefits—information is acquired which is of no immediate use. This is very different from the animal learning which conforms to an operant conditioning model—there, the benefits have to be relatively short-term or else the behaviour does not get reinforced. Animals learn things that are relevant to their current situation. Humans, apparently, sometimes acquire information that is of no benefit at all, long-term or short-term.

[7] Thanks to Kim Sterelny for this point.

It may be, however, that there are internal benefits to acquiring apparently useless information. We might be hardwired to get satisfaction from acquiring new beliefs, or (more narrowly, and more usefully) from acquiring new beliefs that we take to be well-confirmed.

Whether or not this is so, the process by which I acquired the belief that Paris is the capital of France is not a selection process, even though relevant information is sorted out from irrelevant. There is no consideration of alternative hypotheses—what is discarded is information like the position of the sentence "Paris is the capital of France" on the page, rather than candidates for belief such as "Paris is the capital of Spain" and "London is the capital of France." Although in some cases alternative hypotheses such as these may have been present in advance and the effect of testimony from a reliable source is to select between them, there are many cases in which no hypotheses on the subject were entertained prior to the testimony that causes you to form the belief.[8]

I take this to show that although some of the processes by which we acquire beliefs may be selection processes, many of them are not. Operant conditioning may well be a selection process, but most human belief acquisition does not occur by means of operant conditioning. Trial and error learning in general has many of the characteristics of a selection process, and in some cases, provided we can specify what it is that reproduces and interacts with the environment in ways which affect its reproductive success, it may be a selection process. However, many of our beliefs are formed as a result of testimony from sources we take to be reliable, and the process by which this occurs is definitely not a selection process. So the claim that processes of belief acquisition are selection processes cannot be used by the teleosemanticist as a general explanation of how non-innate beliefs get to have proper functions.

Is concept acquisition a selection process?

There is, as yet, no consensus in psychology about how infants acquire concepts. In this section I will consider what concept acquisition would have to be like if it were to be a selection process, and raise some problems which an account of concept acquisition as a selection process would have to surmount.

Suppose we are born with some concepts already in place (For example, Spelke 1985 argues that neonates already have the notion of a physical object.). Then the question is, how do we acquire further ways of categorizing the objects we perceive? The point made earlier about colour concepts is true for a wide range of concepts—language acquisition alters some categorizations, but infants begin to

[8] Soames (1989, p. 589) argues that I can acquire a belief such as the belief that Paris is the capital of France simply by hearing, understanding and accepting a sentence that expresses it. I may need to know that "Paris" and "France", say, are names (maybe even that they are place names) and I may also need to know roughly what it means for something to be the capital of something else, but our syntactic competence will do the rest. On hearing, understanding and accepting the sentence "Paris is the capital of France", I come to hold a belief, whether or not I know where Paris or France is. If Soames is right that we do sometimes gain beliefs in this way, then such acquisition processes are good examples of ones that do not involve discarding alternative hypotheses.

categorize things before they begin to understand speech and long before they begin to speak themselves (See Hayne 1996, p. 113.).

Some cognitive scientists, for example Massimo Piatelli-Palmerini, describe their theories of concept acquisition as selectional (as opposed to instructional) theories. Piatelli-Palmerini argues that there is an array of “highly specific dispositions and structures already present in the organism *before* any encounter with the outside world” (Piatelli-Palmerini 1989, p. 4), and that which of these are fixed or developed depends on which environmental conditions are encountered. However, it is not clear that this is a selection process rather than a mere sorting process.

For the process of concept acquisition to be a selection process, there would have to be reproducing entities that varied, and their variations would have to influence the success with which they reproduce. Suppose, then, that different categorizations of objects are the entities in question, and that we start out by categorizing objects rather indiscriminately in a wide range of ways. Some of these ways of categorizing lead to better consequences than others, so they are the ones that continue to be used.

What would the function of a concept be—what might a concept be selected for? On the face of it, a concept on its own confers no advantage on its possessor: it is only the fact that we can stick our concepts together to form representations of states of affairs that makes concepts useful. A concept must be part of an intentional state, and the intentional state must play a role in causing behaviour, before there could be selection for possession of a particular concept. Having concepts enables us to form beliefs and desires, and beliefs and desires are what enable us to negotiate our environment and what cause us to try to change it.

Given this, it might be thought that infant concept-acquisition cannot be a selection process, since infants acquire concepts before they are capable of doing much behaving. The good consequences that would account for the fixation of one concept rather than another are not going to be pats on the head when you get it right. So, as with belief acquisition, there is a prima facie problem with regarding concept acquisition during infancy as a selection process. It looks as though in many cases concepts are acquired but not used until later—they are acquired for their own sake, without identifiable immediate rewards.

However, there are a couple of reasons to doubt that this is so. One is that that infants do in fact engage in subtle forms of social behaviour; it has been argued that this increases their fitness (Hrdy 1999, p. 483). Another is that, as suggested above, not all rewards need come in the form of external feedback: concept-formation may have internal rewards. Certain ways of categorizing things may be more satisfying than others. Perhaps infants get pleasure from carving up their environment more finely. Or perhaps they get pleasure from being able to perform cognitive tasks for which carving up their environment more finely is a prerequisite, whether or not this cognitive processing has any manifest effect on their behaviour. This is pure speculation—the question is an empirical one, and the research has not been done—but it seems possible and even plausible that they might.

Again, however, it is not clear that there is any reproduction or copying going on here. As the story is told by Piatelli-Palmerini and other selectionists, there is a population of protoconcepts, or dispositions and structures, and the environment sorts them, causing some to be perpetuated and others to disappear, but nothing *proliferates*.

A selectionist might hope to avoid this problem by considering tokenings of concepts rather than concepts themselves: perhaps my tokening of the concept "blue" when I see something blue can be seen as a descendant of my earlier tokenings of the concept. Then the same issues arise as in the case of belief acquisition: the selectionist needs a more precise specification of the ancestor/descendant relation in order to make the case that tokenings of concepts bear this relation to each other.

I take this to be a challenge to anyone who claims that processes of concept acquisition are selection processes: a challenge to spell out the details of what the relevant lineages are. The important point is that to claim that a process is a selection process is to claim more than simply that it is a sorting process: it must also be a process which includes reproduction and differential reproductive success.

Where does this leave the teleosemanticist?

The first suggestion as to how the teleosemanticist might develop the idea that learning processes are selection processes failed: even if some of the processes by which we acquire beliefs are selection processes, not enough of them are for the teleosemanticist's purposes. The second suggestion was that concept acquisition might be a selection process that would give concepts proper functions, and beliefs might then have proper functions in virtue of being composed of concepts.

I have argued that the claim that concept acquisition is a selection process requires the specification of what replicates or is copied in the process of concept acquisition. Further, I have suggested that this is not a straightforward matter. But even if concept acquisition did turn out to be a selection process the second teleosemantic strategy would not work, because proper functions are not compositional: the proper function of a complex item is not a function (in the mathematical sense) of the proper functions of its parts.

Recall that according to the view we are currently considering, beliefs are not the products of selection processes but concepts are. Consequently on this view concepts have proper functions, and, the claim is, since beliefs are composed of concepts beliefs have proper functions too. My belief that snow is white has as its components the concept of snow, the concept of whiteness and the concept of predication. The claim is that the belief has a proper function because those component concepts do.

It is uncontroversial that a belief's *content* depends on the content of its constituent concepts. However, unlike meanings, proper functions do not compose in this way. As Peter Godfrey-Smith (1996, p. 677) puts it, you cannot "read off" the function of a device from the functions of its component parts. And something cannot acquire a proper function simply in virtue of its parts having proper functions, if it is not itself the product of a selection process or of design.

Consider my can-opener, which has the function of opening cans. Its component parts each have their own function. There is a circular blade, which has the function of cutting through the top of the can: there is a handle, which has the function of turning a cog, which has the function of turning the blade. Suppose that the can-opener was neither designed to open cans nor selected for opening cans. Could it be the case that it nevertheless had the function of opening cans in virtue of the functions of its parts?

It is difficult to think of a plausible situation in which the parts would have proper functions as a result of either design or selection but the whole device would not itself have a proper function as a result of design or selection. Consider, perhaps, a situation in which the parts are removed from other devices and accidentally come together into a device which opens cans (cf. Godfrey-Smith 1996, pp. 677–678). Could the device have the function of opening cans purely in virtue of the functions of its parts? The answer is clearly "no." The handle has the function of turning the cog and the cog has the function of turning the blade and the blade has the function of cutting through the top of the can. That is what they are for. But the whole device is not for anything—if its parts perform their functions, it will in fact open cans, but that will not be its proper function.

The fact that a complex item is composed of items that have proper functions does not suffice to give the complex item itself a proper function. Thus even if concepts had proper functions because they were acquired by a selection process, that on its own would not ground the ascription of proper functions to beliefs.

Consequently the attempt to defend the claim that non-innate beliefs have proper functions via defending the claim that learning processes are selection processes fails. Many processes of belief acquisition are not selection processes. There is reason to think that the processes by which we acquire concepts are not selection processes either, but even if they are, that will only ground the ascription of proper functions to concepts, not to beliefs. The teleosemanticist needs another way of ascribing proper functions to beliefs.

Conclusion

What options remain open to the teleosemanticist? One alternative, as suggested in the introduction, is the path taken by Ruth Millikan. According to Millikan, belief-forming *mechanisms* have proper functions as a result of natural selection, and beliefs themselves have proper functions not directly, because they are themselves the products of some selection process, but indirectly, because they are the products of mechanisms which have proper functions.

There is another option, which does not ground the ascription of proper functions to beliefs but might nevertheless form the basis of a kind of teleosemantics. If it should turn out that concepts are acquired by selection processes, then concepts can have proper functions, so (if these functions are of the right kind) concepts can have content. Then it might be that even if beliefs do not themselves have proper functions, they have content because they are composed of concepts that have content.[9]

[9] Too many people to list have given useful comments on earlier versions of this paper: my thanks to all of them, and in particular to Maite Ezcurdia, Jonathan McKeown-Green, Tahua O'Leary and Kim Sterelny.

References

Bornstein M (1985) Infant into adult: unity to diversity in the development of visual categorization. In: Mehler J, Fox R (eds) Neonate cognition: beyond the blooming, buzzing confusion. Lawrence Erlbaum Associates, Hilldale, NJ, pp 115–138

Chomsky N (1959) Review of B.F. Skinner's *Verbal Behavior*. Language 35:26–58

Darden L, Cain J (1989) Selection type theories. Philos Sci 56:106–129

Godfrey-Smith P (1996) Meaning, models and selection: a review of *Philosophical Naturalism*. Philos Phenomenol Res 61:673–678

Godfrey-Smith P (2001) The role of information and replication in selection processes. Behav Brain Sci 24:538

Hayne H (1996) Categorization in infancy. In: Rovee-Collier C, Lipsitt L (eds) Advances in infancy research, vol 10. Ablex Publishing Corporation, New Jersey, pp 79–120

Hrdy S (1999) Mother nature: a history of mothers, infants and natural selection. Pantheon House, New York

Hull, David L, Langman, Rodney E, Glenn Sigrid S (2001) A general account of selection: biology, immunology and behavior. Behav Brain Sci 24:511–527

Millikan R (1984) Language, thought and other biological categories. MIT Press, Cambridge, Mass

Neander K (1991a) Functions as selected effects: the conceptual analyst's defense. Philos Sci 58:168–184

Papineau D (1987) Reality and representation. Basil Blackwell, Oxford

Papineau D (1993) Philosophical naturalism. Basil Blackwell, Cambridge, MA

Piatelli-Palmerini M (1989) Evolution, selection and cognition: from "learning" to parameter setting in biology and in the study of language. Cognition 31:1–44

Soames Scott (1989) Semantics and semantic competence. Philos Perspect 3:575–596

Spelke E (1985) Perception of unity, persistence, and identity: thoughts on infant's conceptions of objects. In: Mehler J, Fox R (eds) Neonate cognition: beyond the blooming, buzzing confusion. Lawrence Erlbaum Associates, Hilldale, NJ, pp 89–114