New Ideas in Psychology xxx (2015) 1–8

Contents lists available at ScienceDirect

New Ideas in Psychology

journal homepage: www.elsevier.com/locate/newideapsych

Concepts as soft detectors – On the role concepts play in perception

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ARTICLE INFO

Article history:
Received 8 December 2013
Received in revised form 18 January 2015
Accepted 8 March 2015
Available online xxxx

Keywords:
Perception
Concepts
Indirect perception
Direct perception

ABSTRACT

The idea that concepts play a significant role in some perceptions is widespread but everybody seems to differ as to where to draw the line. Some researchers say that the difference between direct and indirect, concept driven acts of perception manifests itself whenever we perceive abstract or general properties. Others point at second order properties or causal properties. I call this inability to precisely differentiate between acts of direct and indirect perception "The Division Problem". Furthermore there is always a question as to how widespread indirect perceptions are. Can we attribute them to pre-lingual cognitive systems? I call this second problem "The Distribution Problem".

The main aim of the paper is providing a solution to both problems by proposing a naturalistic explication of the notion of "concept".

I propose to identify the role concepts were supposed to play in perception with a mechanism of "soft detection". Unlike hard detectors which react to a specific target in virtue of their constitution and placement in the system, soft detectors are understood as dynamic categorization devices enabling the cognitive system to selectively react to an undetectable property via flexible exploitation of data from hard detectors.

I conclude by showing how the notion of soft detection retains some of the aspects traditionally attributed to concepts and how does it differ from similar accounts known from contemporary literature.

1. Two problems of perception

The idea that concepts[1] play a significant role in at least some acts of perception is definitely quite old and can be traced back at least to Descartes. In a famous passage he realizes that a piece of wax he looks at isn't literally "seen" because what can be literally seen is a set of simple properties and not a complex property like "being a piece of wax." The passage ends with a simpler and even more persuasive argument. Descartes notices that saying that he "sees" people on the street is somewhat risky, as they might just as well have been automatons dressed as people (Descartes, 1996, p. 21). The property of "being human" isn't something one can observe with a naked eye, one needs the help of one's mind's eye, or at least that's how the story goes.

Even nowadays this intuition is rather widespread but everybody seems to differ as to where to draw the line. For example Galen Strawson (1994, p. 4) describes seeing as if deploying concepts in perception was a standard procedure. This line of thinking goes back to the attack on the myth of the given by Wilfrid Sellars (1956) and seems to be

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[1] As Machery points out "concepts" are best understood as an umbrella term. What I mean by "concepts" from now on is the specific notion used in context of perception, which is roughly equivalent to "categorization device". This pretty broad sense is compatible with how most psychologists and traditional philosophers of mind have used the word (Machery, 2011, p. 31). It is worth noting that "categorization" should be understood in a very basic sense: as identification as a member of a class and not as predication or any other sophisticated cognitive operation (for the more sophisticated sense of categorization see Millikan, 2004a, p. 71).

http://dx.doi.org/10.1016/j.newideapsych.2015.03.001

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still popular today (Goff, 2012). Some researchers resort to notions of generality or abstractness (Block, 2008, p. 307; Grush, 2007, p. 504) — as if we were supposed to be able to see without concepts as long as the term referring to the object we see isn't abstract or very general. For example, Dretske (2002) argues that we don't have to know that something is an armadillo (and thus use the concept of armadillo) to see an armadillo on the road, but he is not so sure about the possibility of seeing an armadillo on the road without knowing that it is an animal (and thus having the concept of "animal"). Along somewhat similar lines Millar (1991) argues that we cannot perceive a pumpkin without a corresponding concept.

Sometimes generality and abstractness are invoked directly (see Murphy & Medin, 1985 or Gelman & Markman, 1986), sometimes they are implied in examples or experiments (Mandler, 2003). Some researchers seem to think that concepts enter the picture when the observer displays the ability to perceive second-order properties (Wasserman, 2002), kind properties (Siegel, 2006) or causal properties (P. Strawson, 1985; Taylor, Hunt, Medina, & Gray, 2009). In the spirit of British empiricists and early positivists, perceivable properties are often divided into simple and complex and seeing the latter is supposed to involve concepts. But the division is typically either vague or seems highly arbitrary (Armstrong, 1993, p. 235).

The dichotomy I am interested in is often indicated by a linguistic difference, between a simple act of "seeing" and a complex, conceptually loaded act of "seeing as" (Dretske, 1995, p.65).[2] Needless to say, showing that the vague difference has a linguistic counterpart does not solve the problem. Let's call this inability to settle on the boundary between simple and complex perception "the Division Problem".

The Division Problem is more strongly emphasized when we move from people to different cognitive systems. We do not have to go very far; it is enough to turn to descriptions of perception in non-human animals and infants. Consider the following simple argument:

A dog sees the postman
The postman is the best chess player in the city
Thus, the dog sees the best chess player in the city.

Needless to say, the argument is formally valid but one may nonetheless refrain from accepting the conclusion.[3] One might say that the conclusion is just a shortcut for something like: "the dog sees the postman we know to be the best chess player in the city" because to see the best chess player in the city implies, among other things, having the concept of chess. But then again doesn't seeing the postman imply having a bunch of concepts that are probably too complicated for a dog to grasp, like a concept of a letter or a post office? So maybe the only thing the dog can see is a man dressed in a particular way? But then again – what exactly do dogs know about dressing? In fact, as I argued elsewhere (Grabarczyk, 2013), once you go this route you might find yourself questioning animals' ability to see any objects at all (as opposed to seeing properties or events). The less complicated cognitive system you choose, the more aggravating the problem gets. Even if you wished to bite the bullet and decided that dogs do have the concept of chess you might start to hesitate when we switch dogs to fish, insects or simple artificial systems. In other words, even if indirect, concept driven perception exist, we have no clue as to how widespread it is. Let's call this problem "the Distribution Problem".

The Division Problem and the Distribution Problem shouldn't be confused with each other. They are obviously connected but nonetheless distinct. It could turn out that the solution to the first problem gives us the tools to differentiate between direct and indirect perception but only for complex cognitive systems; for example, it might turn out that the solution depends somehow on verbal reports from the perceiver. Alternatively it may turn out that indirect perception is possible only with complex systems (which solves the Distribution Problem) but that we are still unable to differentiate between direct and indirect perception (and are unable to solve the Division Problem).

Note that the Division Problem cannot simply be solved by appealing to a difference between subpersonal and personal perceptual states. At first glance it might be tempting to identify states of direct perception with subpersonal states. The temptation arises because the distinction between subpersonal and personal states is definitely more clearly drawn than the difference between direct and indirect perception. But there are several reasons not to go this route. First of all, the examples of direct, nonconceptual perception, like perception of colors, simple shapes etc., that have been indicated in the literature since Locke, are all examples of personal states. Second, there is nothing in the idea of a subpersonal state that prevents it from being determined by higher cognitive capabilities.

It might be tempting to decide that the whole dichotomy is ill-posed and should be abandoned altogether, but the options we are then left with aren't very attractive either. Should we decide that perception is in every case conceptually indebted and most creatures simply do not perceive in the sense we, as concept users, understand it (Carruthers, 1989)? Or maybe we should go the other route and decide that perception is always direct and no one ever really needs concepts in perception? That is why I prefer to give the dichotomy between direct and indirect perception a chance by introducing a naturalistic explication of the notion of concept. I propose this in section 2. In section 3 I show how it can help us to solve both the Division and the Distribution problem as well as why it retains some of the intuitions associated commonly with concepts. In the last section i show how my notion of concepts differs from some of the similar ideas in the contemporary literature.

2. Soft detectors

All natural and artificial cognitive systems cannot be isolated from the environment and have to employ some

[2] "Seeing as" should not be confused with "seeing that." For a useful discussion of the latter see Crane (2009).

[3] The reason for this is that at least some uses of the verb "to see" create an intensional context (Anscombe, 1965). I do not discuss this problem in this paper but see (Grabarczyk, 2014) for a possible extensional explication of the term "to see". This problem can be also analyzed using *de dicto*/*de re* distinction.

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detecting capabilities. These are possible thanks to receptors of some kind. Some of them are quite sophisticated and even controversial (for example the infamous “bug detector” in a frog; Lettvin, Maturana, McCulloch, & Pitts, 1959) while others' operation is fairly obvious because it is determined by their physical construction. Although details of their functioning may be complicated from a technical or anatomical standpoint, there is nothing philosophically puzzling about them. A thorough examination of such detectors and their place in the system's cognitive information flow is all that is needed for us to decide what it is that they detect. For example, studying a retina and seeing how it is constructed and how it is connected to the brain enables us to see that it sends signals only when confronted with a very narrow range of stimuli. That is, some of its detection capabilities – for example its spectral sensitivity – are fairly obvious. Compare it with the aforementioned “bug detector”: the controversy it spawned (e.g., Dretske, 2000, p. 67) arises in part because in order to establish its function we have to relate it to the phylogeny of the organism and phylogenetically defined functions are epiphenomenal (Bickhard, 2009). But when asking whether the frog has a detector that reacts to black objects we don't have to make an epiphenomenal appeals to functions. Let's call detectors which require no appeals to epiphenomenal functions “hard detectors”.

Of course there are lots of properties in the cognitive system's environment which cannot be detected using the system's hard detectors has that would still be beneficial to be able to detect. The fact that these properties cannot be normally detected does not make a given cognitive system oblivious to them. It reacts to them in the sense of being affected by them (but not via hard detectors). For example, a cognitive system without any receptors enabling it to probe the temperature of its environment can be nonetheless affected by it: it can freeze, melt or change its operations in a more subtle way. Still, we couldn't call these reactions “a detection” — the fact that my body reacts to a highly radioactive environment does not mean that I can detect radioactivity. Sometimes cognitive systems detect internal states which are effects of these interactions and some of these internal states may be very important for their survival. For example, if I learn to react to a poison I cannot detect because I learned the symptoms of the poisoning I may live longer. Thus, when a cognitive system is in luck and finds a co-referential property that is detectable for it (because it has a proper hard detector for this co-referential property) it can exploit this discovery. Let's call this situation a case of “proxy detection.”

For example, a stickleback can detect the redness of objects directly and we don't have to appeal to its phylogeny to explain the mechanism by which it detects red things. But a female fish also uses this receptor as a proxy detector. It uses it to find males. Note that at the first glance you could as well say that it detects males, but you shouldn't be too attached to this description. In fact it may be argued that interpreting the fish's reaction as “detecting males” is anthropocentrism and violates Lloyd Morgan's Canon. Note that this supposed “male detector” is too tightly connected with redness detector and surprisingly rigid – it is not open to correction. The female fish is equally attracted to red dummies as it is to males (Tinbergen, 1953). It may be safer to say that it finds the color red sexually attractive than that it finds males sexually attractive.

In fact we can easily find something similar in our own experience. Most people are averse to very bitter things but they are genuinely surprised when they learn that this aversion can be traced back to the fact that many poisons have bitter taste. Yet, if a different intelligent life were to describe our reactions it might have just as easily said that we are averse to poison. Another, similar example is that humans are typically attracted to sweets. Later we may learn that it is so because sweet things have high caloric value. We may be surprised because in our experience we are attracted to the property of being sweet and not to the property of having a high caloric value. And even after we learn “the true nature” of this proxy detection our habits do not change. That's why artificial sweeteners work.

But sometimes the undetectable property is much more elusive. It seems to be present in a very heterogeneous group of objects. Consider the category of “food.” In contrast to the categories we just mentioned, it is much more flexible. Many living organisms don't need much training to learn to eat things which are vastly dissimilar to the food they previously found in their natural habitat. Another example would be the category of “tasty” objects. What the organism detects when it encounters tasty objects is only an internal state of a specific pleasure and not the property that causes it. The problem is that the set of tasty objects is rather heterogeneous. But the need to detect tasty things is pressing. We could metaphorically say that the organism “assumes” a hidden intrinsic feature of all tasty objects. I used parentheses because this assumption isn't propositional. It isn't even a conscious decision. What I mean is only that the cognitive system in question has a specific mechanism of using detectable cues in a peculiar way: it relies on them but is in a constant readiness to replace them on the fly. The data coming from hard detectors can be, and often are, replaced by different data, according to the system's experiences. Think how rigid the frog's “bug detector” is by comparison to the mechanism rats employ when they learn to avoid food after an exposure to poison.

Let me describe it step by step: let's say that the cognitive system enters an internal state which it recognizes (via an internal hard detector) and which it values (positively or negatively). For example it feels pain. The cognitive system cannot detect the external cause of the state because it does not have a specific hard detector targeted on this distal property. For example, it cannot detect a certain poison. Sometimes it finds “the next best thing,” a property which is directly correlated with the undetectable one, and the former starts to function as a proxy for the latter. The cognitive system may react, for example, with aversion to bitter food. But if a strong correlation cannot be found the cognitive system can still look for something weaker because finding some correlation is always better than succumbing to a random strategy. The system uses a collection of hard-detected cues which are relatively well correlated with the valued internal state.

The important thing is that the combination of signals isn't utilized the way the proxy detector was used; it works

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more like a symptom or a working hypothesis in that it is always open to corrections. Its function is to target the property which isn't detectable and not simply replace it, as in the case of a proxy detector. Any detectable property which is used to fulfill this aim may be otherwise completely irrelevant. The cognitive system is ready to abandon such cues whenever they stop being useful and find new ones. We can learn that the poisonous substance has a certain color (most of the time) or comes from a certain source (most of the time) but we may then abandon both of these cues in a new environment. The ability to correct our behavior comes from the ability to detect the internal state which was the main reason we started to look for undetectable causes. Some tasty food may become perceived "as poison" provided that the cognitive system is deceived by it enough times. We could say that this ability to use cues without being attached to them is the ability to see past them: the cognitive system acts as if it directly perceived the undetectable property which caused the internal state the system values. Let's call this type of detection mechanism a "soft detector," and the properties it relies on "auxiliary properties".

It might be easier to grasp the idea of soft detectors if we compare them to the way organisms recognize individuals (such as our family members). We do not have to construct anything similar to the traditional philosophical "concept" (understood as a set of necessary and sufficient conditions) or to a prototype. What we do instead is that we use a more or less extensive set of reliable cues and change them when needed (Millikan, 2004b, p. 74).

It is also helpful to contrast this flexibility with those features we detect by hard detectors and with the *ad hoc* categories human beings can produce via language descriptions (Barsalou, 1983). In the first case the receptor has simply been selected or designed for a particular task and it either does the job or it doesn't. It cannot be replaced even if it becomes erratic or obsolete in a new environment. On the other hand artificial *ad hoc* categories concern properties picked out by humans with descriptions like "objects I packed for the trip". We are free when we create them but, once established, they are rigid. What belongs to a given *ad hoc* category is strictly determined by the content of a relevant description. The mechanism of soft detection is set to detect an undetectable property. That's why it cannot simply produce an artificial equivalent of its target constructed out of detectable auxiliary properties functioning as necessary or sufficient conditions—it could easily lose its real target.

To sum it up, let's compare three types of detectors I was talking about above:
Hard detectors are receptors which can be described without appealing to epiphenomenal functional properties.
Proxy detectors are those hard detectors which are rigidly used by the cognitive system to detect features that happen to be correlated with some other features the cognitive system cannot detect via its hard detectors.
Soft detectors are used to selectively react to an undetectable property correlated with one of the system's detectable internal states. They operate on data provided from hard and proxy detectors and are highly flexible.

3. Concepts as soft detectors

As announced in the title, I wish to identify concepts with soft detectors. Let's see why this might be a good idea. First, how soft detectors can help us in solving the Division and the Distribution Problems. Next, how they qualify as a good explication of "concepts"; that is, they retain enough important aspects of the original notion.

Soft detectors explain the difference between simple and complex acts of perception—that is, solve the Division Problem—in a naturalistic and rather straightforward way. Simple, "pure" or "direct" perception is perception realized via hard detectors.[4] Complex, indirect or concept-laden perception is what is realized via soft detectors. Whichever way a given organism detects a given property is a matter of empirical study. We can learn the answer by studying the receptor set of a given cognitive system (its set of hard detectors) and its behavior (whether or not it is easily deceived by dummy targets, whether the detection mechanism is rigid or not, etc.).

This might be a good place for a reminder that the distinction we obtain by appealing to soft detectors is always relative to a given cognitive system. One system's soft detector can be a hard detector in another. Everything can be directly perceived—provided the perceiver has the right hardware. For example, humans don't have proper receptors to detect H_2O and because of that they have to rely on soft detectors, as water detection is obviously important. But a different organism or a robot might easily perceived water directly, that is detect H_2O via some kind of hard detector targeted at this substance. We could say that a soft detector works best when it plays the same role as an equivalent hard detector in a different system.

For the same reasons the solution to the Distribution Problem is also at hand. Everything boils down to how many cognitive systems use soft detectors. But now it finally becomes an empirical question to be answered by biologists and etiologists. It may be that some organisms do not have any soft detectors; not every cognitive system has to have them. Some systems can survive using only hard and proxy detectors — Fodor's (1986) paramecia likely are a good example. Note that the mechanism of soft detection does not automatically exclude basic cognitive systems as it is fairly simple. In particular, it does not demand that the organism have any form of linguistic capability. The only thing that is needed is the ability to flexibly exploit the data provided by hard and proxy detectors and use it as cues for some undetectable property correlated with one of the system's internal states. So both problems that made the distinction between direct and indirect perception vague are now solvable by empirical means. To solve the Division Problem you have to study the set of detectors of a given system or species of systems, and to solve the Division Problem you have to study different species of cognitive systems.

[4] It may very well be the case that the number of actual hard detectors found in living organisms turns out to be rather modest. It would then be, in fact, in sync with philosophical tradition as lists of directly perceivable properties have always been short.

The crucial reason why it is a good idea to treat soft detectors as an explanation of concepts is that they do exactly the same job that concepts were supposed to do — they create a surrogate for perception where literal perception isn't possible. They enable cognitive systems to selectively react to undetectable properties and they do it transparently: the cognitive system reacts as if it perceived the undetectable property. We perceive the piece of wax because we soft-detect it. Let me remind you that this illusion of perception comes from the flexibility of soft detectors. Cognitive systems act as if they detected an undetectable property because they never become attached to the auxiliary properties they perceive through their hard and proxy detectors. It is different in the case of proxy detectors. The illusion of perception of an undetectable property breaks once we realize that proxy detectors are systematically fooled by dummy targets. In the case of soft detectors the illusion persists because they change when the cognitive system discovers an error (that is, a target which has the usual auxiliary properties but does not produce a desired internal state). You could say that because of its soft detectors the cognitive system can see past the auxiliary properties.

Another important reason for understanding concepts this way is that soft detectors help us understand why, although we know that some of the properties cannot literally be seen, we still tend to prefer to describe these acts of perception as direct perception. Let me give you an example. As mentioned above, we could pretty safely say that we do not have a hard detector for H_2O. What we do instead is use a collection of cues we detect via our hard detectors (for example, by our taste buds) but, contrary to the proxy detector of high caloric values we discussed above, we can easily change the cues when needed (for example, when the water from the reservoir we use changes its taste). Consider how it is reflected in our common descriptions of our perception: even after we learn about our proxy detector we still say that we experience sweetness (and not high caloric value). For some reason we don't care about the undetectable property. But we tend to say that we see water, although, as Descartes would have probably pointed out to us, we can technically only see translucent liquid. So in the case of water it is the undetectable property we are focused on. The reason is that the proxy detector was (and always is) set on detecting sweet things while the soft detector we use to detect water was (and always is) set on the single elusive property that links all the different portions of liquid we have found to have similar effects on us.

Even though I cannot really *see* that something is H_2O or that something is a "human being," etc., saying so remains the most natural verbal report of my perception. Soft detectors help us understand that what we really mean when we say, for example, that a dog sees a postman is that it successfully targets the undetectable property of being a postman. We say that it sees a postman and not the symptoms of being a postman because the symptoms are only temporarily relevant and used as long as they correlate with some internal property,[5] so in a sense they are opaque.

[5] For example a specific type of irritation only postmen elicit in the dog.

Another aspect of concepts which is often hinted at but which most of the time remains undeveloped is their dependency on their user's experience (Smith, Osherson, Rips, & Keane, 1988). It seems to be highly plausible that the concepts of a child differ from concepts of an adult (Vygotsky, 1986) and that the concepts of people coming from different cultures may be different (Nisbett, 2004). But it is far from obvious how this dependency mechanism actually works. Soft detectors can help us here because of their dynamic nature. They are always in flux because they are the effect of interaction between their user's past and present experiences. Note that soft detectors do not reproduce a well known problem that this sort of relativism normally leads to. Even if two systems use soft detectors that differ in terms of their auxiliary properties, they can be said to be the same detector as long as they are set to detect the same undetectable property.

Last but not least, it is worth pointing out that soft detectors also retain some of the vaguer intuitions associated with concepts and indirect perception (although they do it in a somewhat deflationary way). Similarly to concepts the properties we perceive via soft detectors can be said to be more "general" because they are ascribed to a very heterogeneous group of objects. They can also be said to be "immaterial" or "abstract" because their targets are never really detected by the system's receptors. Furthermore, echoing Locke's distinctions, simple perception seems more certain and less prone to skepticism than perception mediated by soft detectors because the former cannot be changed and the latter is constantly evaluated and ready for modifications. Of course hard detectors can fail us just like every other biological mechanism. But soft detectors may lead to a whole new level of failure because it can always turn out that they don't target any genuine property (when the group of objects happened to be too heterogeneous after all) or that their detection rate has dropped significantly over time (when some of the newly encountered objects didn't fit them as well as the old ones have). Soft detectors are created by a cognitive agent and because of this there is no guarantee that that their targets exist. After all it wouldn't be especially surprising if there was no single property of "being tasty" but it does not change the fact that the system expects it to exist. Keep in mind that this expectation means nothing more than a constant readiness for revisions of the corresponding auxiliary properties.

4. Objections

Up to this point I consciously abstained from clearing up some of the doubts that could have appeared along the way. The reason for it is that I wanted to have a clear presentation of the idea of concepts as soft detectors. It is nonetheless important to avoid some of the foreseeable confusions and answer some of the obvious questions. It is especially needed because soft detectors can be conflated with other ideas known from contemporary literature.

First of all, it is important not to conflate the opposition between soft detectors and *ad hoc* categories on the one hand with the opposition between natural and artificial kinds on the other hand. On the face of it, it might be tempting.[6] Soft detectors arise as part of a natural cognitive process. *Ad hoc* categories are consciously created language artifacts. It is only fitting that the former are better suited for natural kinds and the latter for artifacts. But remember that the cognitive system cannot know *a priori* whether a given object belongs to a natural or artificial kind so its detecting capabilities cannot be based on this distinction. We would have to assume that there exists a prior more basic classification process used to differentiate between artificial and natural kinds. Some of the well known examples of human behavior suggest otherwise: as Putnam (1975) points out in his seminal paper, people often seem to treat artifacts as natural kinds. We probably don't have an artificial/natural detector, although it seems that we can easily distinguish between living and non-living objects (Leslie, 1988). But we shouldn't conflate these: a sliding rock is a natural kind object that is not alive. Moreover, as we established before, there is nothing about soft detectors that precludes basic cognitive systems from using them. For obvious reasons such systems cannot create *ad hoc* categories and because of that probably won't use soft detectors exclusively for natural kinds as they encounter artifacts in their environment.

It is also important not to conflate soft detectors with natural indication; for example, with Millikan's (2004b) “locally natural recurrent signs.” What the cognitive system learns in the case of natural indication is that it should transfer some of the reactions which it normally had when it experienced one stimulus to a new stimulus. For example, it learns that it should escape not only when it sees fire but also when it sees smoke. But these two stimuli do not differ fundamentally, whereas in the case of soft detection the target property is undetectable and the auxiliary properties are detectable. In this sense natural indication is more remindful of proxy detection. But it differs from proxy detection as well in that it doesn't transfer all the reactions to the new stimulus. For example, even though smoke is the natural sign of fire you wouldn't quickly take your hand out of smoke. Similarly, an animal learning how to find its prey may learn to use the droppings of the prey as a sign, but does not try to attack the droppings.

It is also important to differentiate soft detectors from anticipatory mechanisms (like those presented in Noë, 2004). Unlike anticipation soft detection doesn't simply precede a given experience. The experience of the undetectable property never actually takes place. In a sense I have never tasted H_2O — only odorless and tasteless liquids quenching thirst.

The notion arguably closest to soft detectors is Millikan's “substance concept.” Like soft detectors substance concepts do not have to contain “the essence” of their target or its statistical likeness; all that is needed is a bunch of reliable indicators which can be used to recognize their target (Millikan, 2004a). There are nevertheless three important differences between my notion of “soft detectors” and Millikan's notion. First of all Millikan's notion hinges on a specific ontology (hence the name) and my view can be easily modified to suit different ontologies. Second of all, the main reason Millikan introduces substance concepts is to explain the ability to gather knowledge of objects, not to explain perception. It makes no use of the difference between detectable and undetectable properties and it is, in fact, sometimes hard to say whether a given act of recognition calls for a substance concept or not.[7] As such it couldn't help us with our two problems: The Division Problem and The Distribution Problem. The third difference is that Millikan's conception presupposes externalism. A substance concept depends solely on the real or historical kind it is hooked to. This approach does not fit well with my aim of creating a naturalistic explication of the notion of concept (as it is used in the context of perception). To give you a concrete example: if a cognitive system does not differentiate its reactions to jadeite and nephrite (Putnam, 1975) because it enters the same internal state while encountering both, than its soft detector is relatively coarse-grained. We could say that the system has a more general concept of jadeite-nephrite.[8]

Readers may also ask how exactly soft detectors differ from prototypes in the prototype theory of concepts. The single biggest difference is that, just like Millikan's substance concepts, soft detectors can be more deficient in data than prototypes — as long as they serve their function they can use a single cue. Furthermore, as we saw in section 3, soft detection allows us to readily discern between perception that needs conceptual input from perception that does not; that is, solve the Division Problem. You just don't have this possibility with prototypes. Is relatively simple perception, for which there is no need of postulating a soft detector, correlated with a corresponding prototype: a prototype for redness, for example?[9] Or maybe it is rather that prototypes enter the picture only in more complex situations like seeing a postman?

Furthermore, soft detectors do not have some of the well known disadvantages of prototypes. Prototype theory has to deal with something that Machery (2011, p. 85) calls “the selection problem.” It is obvious that prototypes do not consist of fully realized detailed models of the objects they are prototypes of. So what exactly is the selection mechanism which takes some of the typical (or cue-valid) properties and leaves out others? This problem doesn't affect soft detectors. They comprise whatever auxiliary properties prove to be working at the time because their only job is to detect their target. If enough auxiliary properties have been picked, then there is no need to find any more because they never were needed to produce a model of the target.

6 Some researchers propose to differentiate representations according to whether they are representations of natural kinds or artifacts (Komatsu, 1992, p. 513).

7 For example see the discussion about the recognition of a “white thing” (Millikan, 2004a, p. 27).

8 This is also the important difference between soft detectors and Gibson's affordances – affordances are also individuated on the side of the world rather than on the side of the cognitive system (Gibson, 1979).

9 For some researchers it certainly is, see (Rosch, 1973).

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Last but not least, let's address the most general question that might have occurred to the reader. How do we know whether soft detectors exist? What exactly is the status of the account presented in section 2? It is important to understand that the idea of soft detectors does not come as a result of some new empirical discovery. Nor is it a speculation positing a new mental faculty which hopefully will be soon discovered. We already know quite well that we are able to categorize objects according to properties which we have no hard detectors for. We know that we make verbal reports suggesting that we perceive these properties directly, although we cannot perceive them directly in a literal sense of the word. We know that cognitive systems which are a lot simpler than us and whose receptors are not richer than ours behave as if they were able to do perceive the same things we do. We don't need any new empirical data to establish all these facts. Moreover, some of the experiments show that postulated undetected properties tend to have higher priority in the categorization process.[10] Soft detectors fill the theoretical niche traditionally reserved for concepts and help us tell a more believable story about perception because they tie up some of the loose ends we have been having problems with. Their theoretical status is exactly the same as the status of concepts. They are dynamic categorization devices used in perception which can be easily attributed to fairly simple cognitive systems in order to explain their observable behavior.

As I explained at the beginning, I do not want to suggest that soft detectors fit into every context in which we were using the notion of concept. I believe that Machery (2011, p. 52) is right in saying that the notion of concept is heterogeneous[11] In some cases (mathematics springs to mind) what we mean by concepts has much more to do with traditional explicit definitions, with their necessary and sufficient conditions, than with soft detectors.[12] There are cases where it might be better to understand concepts as they are meant to be understood in prototype theory. My point is rather that the idea of soft detectors helps us understand concepts as they appear in some contexts, most notably in the context of perception. In this sense they prove to be a very good explication for the notion of concept. They do things concepts were supposed to do for us, but don't have their main disadvantage. We are no longer burdened by the Division and Distribution problems and can safely retain the classic distinction between direct and indirect perception.

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[10] See Ahn (1998), or Gelman and Markman (1986).

[11] Although I don't share his readiness to eliminate them from scientific vocabulary.

[12] Machery (2011, p. 76) calls it the classical definition of concepts.

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