Concepts are specifically structured and handled mental files

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Abstract

We propose a new account of concepts as specifically structured and handled mental files. We argue that concepts consist of two components, (a) an *associative network of integrated information* used for property based categorization and recognition; and (b) a *handling system* that organizes and sorts through this associative network. A certain type of concept is determined by the package of associated information integrated in a mental file and the specific structure of this information including the specific way this information is handled. With this framework, we can account for the large variety of concepts including everyday concepts of individual objects and properties, scientific concepts, natural kind concepts and phenomenal concepts.

Keywords: Concepts; Mental files; Recognition; Categorization; Variety of concepts

Introduction

Despite their centrality to many philosophical debates, especially for accounts of thought and reasoning, many crucial questions about concepts still remain in need of an answer. We focus on three questions with the first one being the key question: (i) How can we account for the variety of concept types, including basic perception-based concepts, definition-based concepts and natural kind concepts, etc.? (ii) Can we account for it in a unitary framework? (iii) How can we best account for changes in the concept expressed by the same 'word' in the ontogenetic development of humans? To answer these questions we suggest a new account which is situated between accounts of concepts, on which they can be analyzed in terms of associative networks of perceptual information (Barsalou 1999, Prinz 2004), and accounts on which concepts are taken to be abstract symbols radically different in format from perceptual representations (Fodor 1975, Dretske 1983, Peacocke 1992). We develop a positive analysis of concepts which enables us to account for the variety of types of concepts within a unitary framework.[1]

We propose as a unitary framework the cognitive structure of mental files developing the following main claim: concepts can be fruitfully understood as structured mental files consisting of two components: (a) an integrated associative network of information that includes the content components of the mental file, and (b) a handling system that organizes this associative network and results in a specific structure of weighting and using the content components for recognition and categorization.

Setting the stage

In this paper we characterize concepts as mental representations mainly determined *by epistemic abilities*, which do not presuppose the possession of language (Newen, Bartels 2007). Outlining minimal conditions, we focus on two *epistemic abilities* relevant for possessing a concept C, namely *recognition* and *categorization*.[2] Recognition is the epistemic ability to identify the same property *p* across different objects, as well as registering one and the same object as having p among other of its properties. Categorization is the epistemic ability to register when an object (or property) belongs to a previously formed category, e.g. registering being red or green as different members of the category of colours or registering being round or square as different members of the category of shapes (Pepperberg, 1999), or distinguishing between representing a toy as a toy-animal or a toy-human (Pauen, 2000).

[1] Thus, we do not share the skepticism of Machery (2009) according to whom we should stop to search for a unitary characterization of concepts.

[2] We distinguish Fodor's view of concepts from an epistemic theory of concept possession, since he argues that concept possession is completely independent of epistemic abilities (Fodor 1998, 6).

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The idea that concept possession correlates with specific epistemic abilities has a central advantage, namely that such a theory of concepts enables us to predict and understand the cognitive capacities of different systems, including those of robots, prelinguistic children and language-proficient adult humans. We defended the general framework already elsewhere (Newen and Bartels, 2007): the aim of this contribution is to unfold the mental file theory of concepts by showing that it can adequately account for the plurality of types of concepts within this unitary framework[3]. Thus we focus on two (of many) *criteria of adequacy* for a theory of concepts focusing on language-based concepts: (1) A theory of concepts should enable us to attribute a basic concept to young infants which do not yet have a fully adequate understanding of the concept expressed by a word and should account for its ontogenetic unfolding. (2) The theory should account for the varieties of types of concepts including everyday concepts of individual objects and properties, scientific concepts, natural kind concepts and phenomenal concepts.

Concepts as mental files

Historically there is a venerable tradition that posits a radical distinction between the representational formats of concepts and other mental states such a perceptual states (Dretske, 1983; Fodor, 1975; Peacocke, 1992). We accept this distinction and account for it by distinguishing the ability of perceptual discrimination from the ability of forming conceptual representations (Newen and Bartels, 2007). But we maintain that perceptual information does plays a crucial role for concepts: linguistically expressed everyday concepts often involve associated multimodal perceptual information (Barsalou et al. 2003), e.g. our concept of APPLE normally involves the perceptual image of a round object with a certain colour size and weight. Furthermore, we also need to account for abstract or even scientific concepts, such as the concept ATOM.

People may lack an adequate perceptual grounding for such concepts, and the relevant representation seems to be solely constituted by descriptions. Thus, our theory of concepts must include a structure of mental files that can be void of perceptual information and only involve typical descriptive information associated with the scientific concept. Is it possible to account for both perception-based concepts like APPLE as well as for abstract concepts like ATOM within a unitary framework of concepts? If this could be done convincingly, it would be a major step forward in the debate, for it would offer a more cohesive picture of the relationships and differences between perception-based folk concepts and scientific concepts.

In order to develop such an account of concepts, we rely on the *mental files* framework (See Perry 1990, 2002; Kahnemann et al. 1992; Gordon & Irwin 1996; Recanati 2012; Perner et al. 2015). Mental files can be characterized as metaphorical boxes which collect and integrate relevant information pertaining to objects, persons, events, etc.. The information included in a mental file comes from a variety of different sources. Information that even the three year old child, Anna, associates with her red puppet which she names 'Nina' can be structured into five types of information: sensorimotor information (e.g. how the puppet feels when grasping), image-like information (her image of the puppet with colors, form etc.), descriptive information (e.g. being her favorite toy), affective information (e.g. feeling familiarity and joy), social information (e.g. being a present of grandma). We focus on these five types of information but leave it open to enrich them by further types to include all relevant information associated with this puppet. The five types of information are typically (but not necessarily) involved when we possess a concept expressed by a linguistic label. We can illustrate the mental file approach with this example of Anna's concept of an individual object, namely her puppet 'Nina'. Anna thinks of her puppet based on a mental file which has *a label*, the name 'Nina'; it has a cluster of associated information which is organized in five types of information (see above) and this information is (causally) anchored in the object, namely her red puppet.

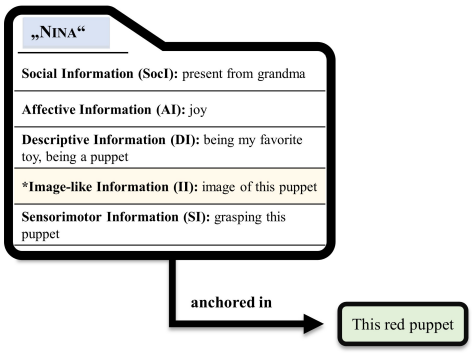

Figure 1: Perception-based concept of an object: the red puppet "NINA"

Note that information within a mental file can vary in scope and detail depending on the expertise of the subject. For instance, a puppet designer will plausibly have more refined content than the child or even an adult layperson: this holds for both image-like and descriptive information, since we accept that our perception is shaped by our descriptive knowledge (Vetter, Newen 2014). A mental file of an object, property etc. is an integrated or unified package of information about the object, property, etc. If a mental file is created on the basis of just one experience of seeing an object it may contain very specific information. After many encounters with the same object, we are able to enrich the mental file with combinations of features of concrete instances of that object as well as statistical averages of features that all those objects tend to share. The enrichment of mental files which is independent of the type of

[3] An earlier version of this framework with some overlapping ideas is published in Newen and Marchi (2016). But now we describe a new version of mental files containing much more types of information, especially affective and social information.

information in the file, be it sensorimotor, image-based, descriptive, affective or social.

After having described the associative information network at the very core of our mental-file based account of concepts, we need to introduce the second component: the *handling system*. Information in mental files is not simply collected, but it also stored in a minimally structured way, which requires an independent system that produces such a structuring of the information. We need to presuppose such a handling system for two reasons: We have already mentioned that humans typically have the ability to develop statistically averaged representations for common properties of objects after repeated encounters. But this presupposes that the relevant associated information is not simply collected, but also weighted and structured according to the degree of typicality of recurrent features. Furthermore, the handling systems allows us to account for the fact that the same network of information can be the basis for both, a natural kind concept and a perception-based concept. Concepts expressed with the word 'water' rely on the same associative network of information illustrated in figures 2 and 3.

The concept expressed by 'water' is *the natural kind concept* of $WATER_2$ if it is introduced with referring to a sample of water that determines the reference. Then the concept is determined by being anchored in the substance that hydrates our bodies, fills lakes and rivers and has a chemical structure of H_2O. If we use the word 'water' such that it would be determined by the associated descriptive surface sensory properties, of being transparent, being tasteless, etc. then it would be a descriptive (and perception-based) concept $WATER_1$. Following Putnam's (1975) famous example, a substance with the chemicals XYZ on Twin Earth would also be an instance of water if the concept $WATER_1$ were to include only to the surface properties since in the famous thought experiment the substance XYZ is supposed to have the same surface properties as water on earth. If someone instead takes the individuating features of the substance as fixing the scope of $WATER_2$, then the chemical structure of H_2O, determines the domain of application of the natural kind concept, excluding XYZ. In our ordinary practice the natural kind concept $WATER_2$ as determined by *the samples of water on earth* (See figure 3. The anchoring relation to the sample is marked by '*' and yellow color). In contrast the descriptive concept $WATER_1$ is determined only by *the surface properties* (see figure 1: the description- (and perception-based concept). Since the associated information in the corresponding mental file is the same, only an independent handling system allows us to understand the difference between the two concepts.

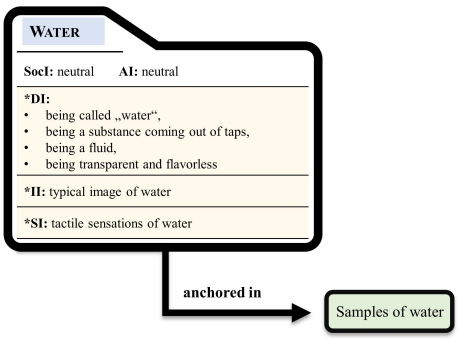

Figure 2: Description- and perception-based concept $WATER_1$

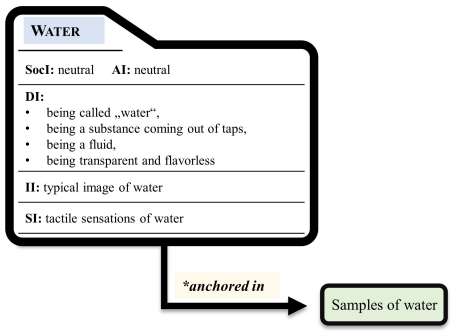

Figure 3: Natural kind concept $WATER_2$

This observation demarcates our view from Barsalou's (1999) theory. Our theory insists on the importance of the handling process which is necessary to account for the difference between types of concepts which may rely on the same associative network of information. i.e. perception-based and natural kind concepts. To clarify this further: Barsalou rightly highlights that the rich associative network of information, e.g. of the concept CAR, is not always completely activated but only a contextually relevant part of it, e.g. in the context of gas stations the location and opening mechanism of the tank and the type of gas are activated while in the context of planning to drive into family holidays the volume for luggage and the air conditioning maybe activated. The contextual selection of associative information is different from a new way of handling the information since we just illustrated that the two concepts of water are different despite being based on the same associative network of information: and this does not change if the associative network is contextually selected.

To summarize: concepts are determined (at least) by two components, an *associative network of integrated information* and a *handling system*. We can integrate the important contextual selection just illustrated as follows. Normally the rich network of information associated with a linguistic label like 'car' is contextually constrained and selectively activated. Thus, a concept is normally based on such a situation-dependent associative network of information and the relevant way of handling this information. Such a situation-dependent type of concept is called a (conceptual) *template.* As we will illustrate shortly, recognition and categorization are realized by a process of

pattern matching, which is based on these templates. As we shall see, templates that are used for recognition and categorization are an adequate way to describe concepts in use in a situation.

Recognition and Categorization with Mental Files

We discussed how recognition and categorization abilities are necessary preconditions for having concepts. We also introduced our general take on the framework of mental files as a model of mental representation, according to which a mental file always comes with a certain degree of internal organization, resulting from the operations of the *handling system*. Suppose that the initial instantiation of a mental file occurs when information pertaining to an object is represented in the system for the first time. We may suppose that the target system does not possess fully developed linguistic abilities at this initial stage. and only represents perceptual information (sensorimotor and image-like). Perceptual interactions with the world involve different sensory modalities and the associated information that gets integrated in the file pertains to different perceptual features, which, however, are already bound together in a specific way. Some visual stimuli are systematically connected with certain auditory stimuli and not with others. This organized way in which perceptual signals come to our sensory organs is based on reliable co-occurrence and allows the system to cluster different stimuli as representations of physical objects, sounds, background, etc. Furthermore, it allows the system to form reliable predictions about the presence of one feature when detecting another. This is enabled by the matching of previously formed object templates generated from stored mental files to incoming signals. This pattern-matching from detected feature clusters to existing templates organized by the handling system constitutes the fundamental process of *recognition.*

Concerning categorization, we may start with basic categorization in nonhuman animals who need the ability to register properties, e.g. being a predator, being edible, being of a higher social rank, etc. Initially, this may be achieved on the basis of some sensorimotor contingencies only, e.g. those that are associated with the property of 'being the Alpha-male in a monkey group'. If the associated sensorimotor and perceptual information is structurally organized and unified, then this structured information forms a respective property-file. Property-files are enriched and structured with rich sensory information which allows to categorize objects according to properties, e.g. as being of a certain social rank, being of the same shape, the same color, the same material, the same basic function, etc. Affordances related to properties can also be integrated (e.g. being a stone or a stick come with the different affordances of hammering and poking objects respectively). Once the property file is enriched to a sufficient degree and adequately associated with other related files it becomes a full-blown concept. Animals endowed with language systems can also integrate descriptive information as part of the property file. Thus *Categorization* involves a process of pattern-matching from detected features to rich-property files also organized, updated and regulated by the handling system. Repeated exposure to the same clusters of objects and properties, provide the corresponding mental file with increasingly complex structure. In future perceptual encounters with similar objects or properties will be categorized on the basis of an increasingly stabilized and detailed template. Now we can address the question of which mental files become structured enough to be classified as concepts.

Which mental files are concepts?

If recognition and categorization are necessary conditions for having concepts one may still wonder whether they also are sufficient. Recognition can be based already on mental-files with only very parsimonious perceptual information, such as some sensorimotor and image-like features that are sufficient to treat an object, for example, as the same across different encounters. If we were to take such a minimal capacity for recognition to be sufficient for having a concept, then this concept ascription would come with problematic theoretical implications, because concept possession would be indistinguishable from the capacity of selective response to stimuli that many simple and inflexible biological and artificial systems already possess. Does the capacity for categorization help here? Let us take for example a young child who starts to generalize some properties of an object such as a toy-car, like its color and texture. This also does not lead to a fruitful ascription of having the concept CAR. What is missing is the capacity to recognize the complex property-property cluster that typically characterize cars and, on this basis, the capacity to categorize different cars, and differentiate them e.g. from being a toy dog and being or a puppet. Our main point is that while mental files of objects and properties can start to unfold with minimal sensorimotor and imagistic content this already sustains the basic abilities of recognition and categorization while this is not sufficient for full-blown concept possession. Concept possession requires a mental file to be systematically enriched, which enables more complex forms of recognition and categorization of objects according to their properties and differentiation from a sufficiently rich contrast class, while while still allowing for variation across specific features (like color and texture) within the set of category members. Such enhanced recognition and categorization capacities presupposes some adequate way of handling the associated information in the mental file. It is only fruitful to attribute a concept to a subject, when this involves the reliable prediction of a cluster of flexible but systematic behavioral dispositions towards objects and properties that fall between the scope of that concept. With the acquisition of a natural language the abilities described above increase exponentially and the mental files becomes rich enough to sustain the multifaceted and extremely intricated conceptual network of human beings. *Thus, possession of a concept is constituted by the activation of a stored mental file in which enough information has been structured by the handling system and*

which can be used for sophisticated property-based recognition and categorization.

Concepts are, thus, *situated mental representations anchored in mental files* (Newen and Vosgerau, 2020). Strictly speaking, mental files are not concepts *per se.* Rather, mental files are the stored background associative information clusters that enable us to activate specifically structured templates in a situation. These templates are the concepts proper. Language allows the addition of descriptive information in the clusters, which comes with its own rich network of inferences, on top of the associative relations of sensorimotor and image-like information. Thus, the enrichment of mental files is exponentially amplified by and closely tied with the development of natural language.

Advantages of our framework

Concepts, we have argued, are situated activations of informational templates based on mental files structured by a handling system. Within this framework, we have shown that we can adequately describe concepts of objects and of properties as well as the difference between descriptive concepts and natural kind concepts. But our framework can also account for the transformation from characteristic-feature concepts into definitional concepts. For example Keil (1992) shows how this transition, e.g. for the concept ISLAND, is characteristic of the ontogenetic development of language understanding. If a 4-year-old child understands the word "island" by activating a concept involving certain characteristic features only, then the objects falling under it are determined by the cluster of perceptual features that directly allow categorization by perceptual pattern matching (figure 4 SI and II, marked yellow).

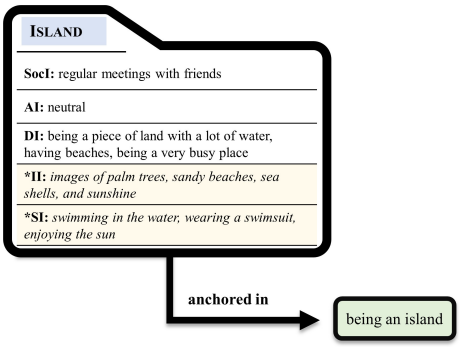

Figure 4: Perception-based concept

If, however, a 9-year-old understands the word "island" with the deployment of a definitional concept, then categorization happens on the basis of one or more critical descriptive features, namely "being a piece of land surrounded by water" (figure 5marked by '*' and yellow color).

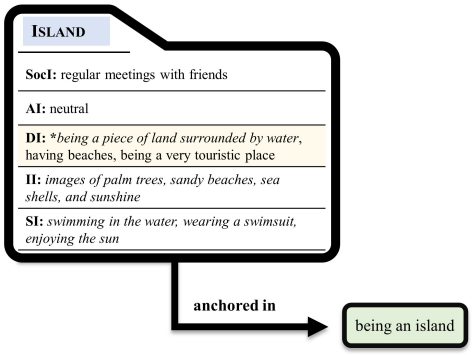

Figure 5: Theory-based concept

Another advantage of the framework of mental files is that it can handle special linguistic flexibilities. The plurality of concepts expressed by one word of a language is not only a product of long-term changes, but can also take place in the understanding of one sentence as a result of the flexibility of the handling system: while pointing to a plate with a vegetarian sausage on it, I utter the sentence "This sausage is not a sausage." The sentence is usually interpreted as expressing that "the object that looks like a sausage" (i.e. sausage in the characteristic-features sense) is not an "item of food in the form of a cylindrical object which contains finely chopped and seasoned meat usually stuffed into a prepared animal intestine." (i.e. sausage in the definitional sense). Thus, by understanding the sentence, we change our interpretation of the very same type of word within one utterance by first activating the perception-based concept SAUSAGE_1 and then activating the theory-based concept SAUSAGE_2. Thus, our theory accounts for two important observations: we can develop a variety of concepts based on one corpus of associated information, and we can use these different concepts rather flexibly, even when they are expressed by the same word, even in the same utterance.

Furthermore, concerning the development of mental files, we may suppose that infants start by representing perceptual (= sensorimotor and image-like) information associatively. When they learn a natural language, they learn to structure this information and to combine it with (at least minimally) complex inferential roles, in relation to other words and sentences. These inferential roles when combined with a word are the main characteristic of descriptive information associated with the word. If we want to highlight the different roles of perceptual information and descriptive information in a mental file, we can characterize the mental file as having the same associative informational basis, while the handling system produces a different template, activated on the basis of the associated information: one template focuses on the cluster of perceptual information as the individuating part, while the other focuses on an descriptive element as the individuating part. Given this perspective, it makes an essential difference whether the concept is determined by features of the perceptual or the descriptive information.

Finally, this framework allows us to account for *abstract concepts*, including concepts expressed by theoretical terms

like the concept GENE or ELECTRON. In the case of scientific concepts, as mentioned above, the concept is often predominantly descriptive. We need not exclude image-like information (II) from being represented in these scientific concept files; we need only rule out that this perceptual information shares the relevance of descriptive information (DI) for the specific inferential network built at this stage. Through scientific theorizing, it is possible to refine the descriptive information contained in (a set of) mental files. Such refinement allows for an even more complex handling of the stored information, and a consequent further improvement of the overall inferential network in which mental files are embedded. Accordingly, we are able to form concepts that unify only descriptive information in the relevant mental file. Then, the concept is determined by this descriptive information and its role in the inferential network, characterized for natural language representations.

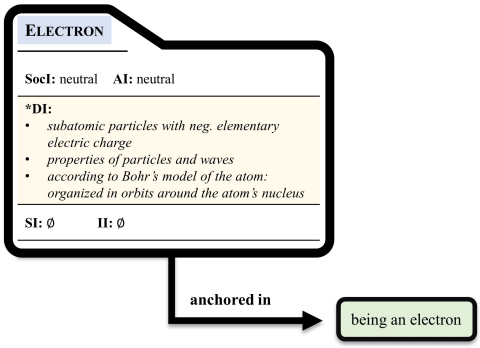

Figure 6: Scientific concept of Electron

An example is the mental file of the concept ELECTRON, which characterizes the standard representation one learns at school (see above). We may call concepts that rely only on descriptive information "purely descriptive concepts." In the case of purely descriptive concepts, the possibility of establishing connections among different files no longer depends on the characteristic-features information encoded in such files, as was the case in previous stages. This mirrors a feature of natural language: the inferential network established among linguistically expressed concepts becomes step by step more independent of perceptual features and exponentially more powerful. During ontogeny, children first learn concepts by developing files based on sensorimotor and image-like information, while later the same files involve more and more descriptive information, as we illustrated in the transformation from characteristic-features concepts to definitional concepts. On the basis of a rich inferential network, we can learn to understand descriptive concepts, including purely descriptive concepts like ELECTRON (Newen & Marchi 2016).

Finally, we can outline that we can also account for phenomenal concepts like RED-EXPERIENCE (Newen, 2011). The only constitutive condition (for categorization) relying on such a file is *the image-like information* (i.e. a red experience when seeing a tomato). But we can already initiate this file on the basis of descriptions we learn, e.g. also as a blind person: 'the experience a person normally has when seeing a tomato' or 'the experience realized by the neural correlate C1'). Thus, with our framework we can describe the cognitive situation of the neuroscientist Mary in Jackson's famous thought experiment as follows: she has a phenomenal concept (opened by descriptive information) and knows that she lacks the constitutive information of a red experience until she leaves the black and white room and sees first time a tomato. She fills in the new information, the red image, in the already existing concept of RED-EXPERIENCE. Thus, she does not learn a new concept but she fills in the essential information of the phenomenal concept, i.e. the visual impression, into the expected slot and thereby modifies the file as provisionally determined by a description (being the color of a tomato) to permanently determined by the typical visual red-impression.

Conclusion

We have argued that concepts are constituted by two components: (i) an integrated network associative information concerning objects, properties, etc. and (ii) a handling system which organizes and updates this associative network. These two components are implemented in a system of ever-developing mental files stored in long-term memory. Concepts are templates activated in a situation (by working memory) based on mental files. With this theoretical framework of concepts as structured and handled mental files we are able to account for the large variety of types of concepts within a unitary framework.

Acknowledgments

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References

Barsalou, L. W. (1999). Perceptual symbol system. *Behavioral and Brain Science,* 22, 637-660.

Barsalou L. W, Kyle Simmons W., Barbey A. K. and Wilson C. D. (2003). Grounding conceptual knowledge in modality-specific systems. *Trends in Cognitive Science*, 7, 84-91.

Dretske, F. (1983). *Knowledge and the flow of information*, Cambridge, MA: MIT Press.

Fodor, J. (1975) *The Language of Thought*. Cambridge, MA: Harvard University Press.

Fodor, J. (1998) *Concepts. Where Cognitive Science Went Wrong*. Oxford: Oxford University Press.

Gordon R.D. and Irwin D.E. (1996) What's in an object file? Evidence from priming studies. *Percept Psychophysiology,* 58, 1260-77.

Kahnemann, D., Treisman, A. and Gibbs, B.J. (1992). The Reviewing of Object Files: Object-Specific Integration of Information. *Cognitive Psychology,* 24, 175-219.

Keil, F. (1992). *Concepts, Kinds, and Cognitive Development*. Boston: MIT press.
Machery, E. (2009). *Doing without concepts*. Oxford: Oxford University Press.
Newen, A. (2011). Phenomenal Concepts and Mental Files: Phenomenal Concepts are theory-based. *Philosophia naturalis*, 47(1), 155-183.
Newen, A. and Bartels, A. (2007). Animal minds and the possession of concepts. *Philosophical psychology,* 20, 283-308.
Newen, A., and Marchi, F. (2016). Concepts and their organizational structure: Concepts are templates based on mental files. In D. Hommen, C. Kann & T. Osswald (Eds.), Concepts and Categorization. Systematic and Historical Perspective (pp. 197-227). mentis.
Newen, A., & Vosgerau, G. (2020). Situated Mental Representations: Why we need mental representations and how we should understand them. In J. Smortchkova, K. Dolega & T. Schlicht (Eds.), *Mental Representation* (pp. 178-212). Oxford University Press
Pauen, S. (2000). Early differentiation within the animal domain: Are humans something special? *Journal of Experimental Psychology,* 75, 134-151.
Peacocke, C. (1992). *A Study of Concepts.* Cambridge, MA: MIT Press.
Pepperberg, I. (1999). *The Alex Studies*. Cambridge MA: Harvard University Press.
Perner, J., Huemer, M. and Leahy, B. (2015). Mental files and belief: A cognitive theory of how children represent belief and its intensionality. *Cognition,* 145, 77-88.
Perry, J. (1990). Self-Notions. *Logos,* 11, 17-31.
Perry, J. (2002). The Self, Self-Knowledge, and Self-Notions. In Perry, J.: *Identity, Personal Identity and the Self.* Indianapolis.
Prinz, J. (2004). *Furnishing the Mind.* Cambridge MA: MIT Press.
Putnam, H. (1975). The Meaning of 'Meaning'. *Minnesota Studies in the Philosophy of Science,* 7, 131-193.
Recanati, F. (2012). *Mental Files*, Oxford, UK: Oxford University Press.
Vetter, P. and Newen, A. (2014) Varieties of Cognitive Penetration in Visual Perception. *Consciousness & Cognition,* 27, 62-75.