Buxbaum, L.J., Saffran, E.M. (2002). Knowledge of object manipulation and object function: dissociations in apraxic and non-apraxic subjects. Brain and Language, 82, 179–199.
Buxbaum, L.J., Schwartz, M.F., Carew, T. (1997). The role of semantic memory in object use. Cognitive Neuropsychology, 14, 219–254.
Buxbaum, L.J., Veramonti, T., Schwartz, M.F. (2000). Function and manipulation tool knowledge in apraxia: knowing "what for" but not "how". Neurocase, 6, 83–97. Capitani,
E., Laiacona, M., Mahon, B., Caramazza, A. (2003). What are the facts of semantic category-specific deficits? A critical review of the clinical evidence. Cognitive Neuropsychology, 20, 213–261.
Devlin, J., Russell, R., Davis, M., Price, C., Moss, H., Fadili, M., Tyler, L. (2002). Is there an anatomical basis for category-specificity? Semantic memory studies in PET and fMRI. Neuropsychologia, 40, 54–75.
Garcea, F.E., Mahon, B.Z. (2012). What is in a tool concept? Dissociating manipulaiton knowledge from funciton knowledge. Memory and Cognition, 40, 8, 1303-13.
Gibson, J.J. (1979). The ecological approach to visual perception. Boston: Houghton-Mifflin.
Magnie, M.N., Teixeira Ferreira, C., Giusiano, B., Poncet, M. (1999). Category specificity in object agnosia: preservation of sensorimotor experiences related to objects. Neuropsychologia, 37, 67–74.
Negri, G.A., Lunardelli, A., Reverberi, C., Gigli, G.L., Rumiati, R.I. (2007). Degraded semantic knowledge and accurate object use. Cerebral Cortex, 43, 376–388.
Sirigu, A.J., Duhamel, J.R., Poncet, M. (1991). The role of sensorimotor experience in object recognition. Brain, 114, 2555–2573.
Thompson-Schill, S. (2003). Neuroimaging studies of semantic memory: inferring "how" from "where". Neuropsychologia, 41, 280–292.
Warrington, E. K., & McCarthy, R. A. (1987). Categories of knowledge. Further fractionations and an attempted integration. Brain, 110, 1273-1296.
Warrington, E.K., Shallice, T. (1984). Category specific semantic impairments. Brain, 107, 829–853.

How Concepts Differ From Predicates

JEAN-LOUIS DESSALLES
(School of Telecom, Université Paris-Saclay – www.dessalles.fr)

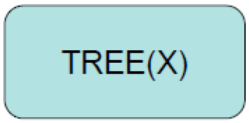
'Concepts' have received different and often irreconcilable definitions in disciplines such as linguistics, cognitive philosophy, artificial intelligence and psychology. Concepts are sometimes regarded as *prototypes*. From this perspective, concepts are characterized by gradualism (topological or metric proximity, membership convexity, typicalitymeasure) and iconicity (same nature as percepts), extensionality (concepts as fuzzy sets or regions in a given space), lack of recursive structure (*i.e.* the internal structure of concepts does not involve further concepts). For instance, P. Gärdenfors' Geometry of meaning presents concepts as convex regions in perceptual spaces (Gärdenfors, 2014).

On the other hand, when considered as elements in sentences or in reasoning processes, concepts are often described as logical *predicates*. By nature, predicates are symbolic (no gradualism), non-iconic, intensional and possibly recursive (predicates may be defined using other predicates, as in KILL(X,Y) = CAUSE(X, DEATH(Y))). For instance, J. Fodor argues that concepts must be symbolic representations (what we call predicates here) if we want to account for compositionality and systematicity

(Fodor, 1998) (note that Fodor strongly refuses the recursive nature of concepts (Fodor et al., 1980)). When membership and extension are considered, it is only with respect to the

definite 'membership set' corresponding to the predicate.

Considering concepts as mental representations, should we regard them as perceptual prototypes or rather as symbolic entities?



Incompatibility. We will show that the two perspectives are cognitively incompatible. Generalized percepts cannot be considered as extensions (membership sets) of predicates, as shown historically by E. Rosch (Rosch & Mervis, 1975). Moreover, we lack convincing mechanisms to explain how concepts, if considered as abstracted from percepts, can be systematically composed. The perceptual composition 'house' + 'boat' may produce unreliable results (this can be tested using a search engine: results range from a barge to a former boat converted into a dwelling or a house with a pediment reminding a sail). Mere association cannot explain systematic aspects of composition.

The words 'Mary sleep' may be linked to a composite scene in which Mary is

lying and sleeps, but we cannot exclude that no such scene would be retrieved when hearing 'Anna sleep'. Systematic composition, however, requires that if SLEEP(MARY) can be represented, so must be SLEEP(ANNA). Fodor, in his controversy with P. Smolensky, showed that systematic composition is absent from graph-based knowledge representations in which concepts are represented by nodes in a graph (*e.g.* in traditional neural networks, even if the nodes correspond, not to single neurons, but to groups of neurons) (Fodor & Pylyshyn, 1988). Conversely, classical predicates forming a coherent compositional system cannot be linked to percepts. Connecting such a system to percepts would be like learning Chinese from a Chinese-Chinese dictionary. This paradox is known as the symbol grounding problem (Harnad, 1990).

Non-recursivity. Following Fodor, we will show that recursive predicates cannot account for cognitive meaning construction: no concept definition is correct (outsidemmathematics[1]); non-circular definitions require undefined primitives, and network definitions lead to holism (Fodor & Lepore, 1992). We may add two more refutations (Ghadakpour, 2003): a recursive representation of meaning requires unrealistic omnipotence (all perceptive nuances should be represented symbolically) and monotony (representation can only grow in size through composition).

Transience. How can we ground concepts in perception while allowing them to enter systematic compositions? Meaning cannot be purely perceptive (contrary to what a basic empiricist approach would suggest). We must stick to the distinction between concepts (as prototypes or elements of a geometrical space) and predicates (as symbolic representations). The latter are unavoidable to account for systematic composition, argument structure and logical negation. My solution consists in (1) keeping the idea that words refer to perceptual representations that are help permanently in memory; (2) abandoning the idea that predicates would be permanent structures (Dessalles, 2015). I will suggest that *predicates are transient representations that are constructed on the fly when meanings are composed*. This operation is based on operations like the *contrast* operation that converts perceptual representations (e.g. points in a geometric space) into symbolic predicates while being sensitive to context. Thanks to contrast, a bonsai will be predicated as a TREE or NOT-A-TREE, depending on the context, and only for a while.

[1] For instance, defining KILL(X ,Y) as CAUSE(X, DEATH(Y)) would wrongly apply to a judge sentencing someone to death penalty.

Dessalles, J.-L. (2015). From conceptual spaces to predicates. In F. Zenker & P. Gärdenfors (Eds.), *Applications of conceptual spaces: The case for geometric knowledge representation*, 17-31. Dordrecht: Springer.

Fodor, J. A. (1998). Concepts: where cognitive science went wrong. Oxford: Clarendon Press.

Fodor, J. A., Garrett, M. F., Walker, E. C. T. & Parkes, C. H. (1980). Against Definitions. *Cognition*, *8* (3), 263-367.

Fodor, J. A. & Lepore, E. (1992). *Holism - A shoper's guide.* Cambridge, MA: Blackwell.

Fodor, J. A. & Pylyshyn, Z. W. (1988). Connectionism and cognitive architecture: A critical analysis. *Cognition*, *28* (1-2), 3-71.

Gärdenfors, P. (2014). The geometry of meaning - Semantics based on conceptual spaces. Cambridge, MA: MIT Press.

Ghadakpour, L. (2003). Le système conceptuel, à l'interface entre le langage, le raisonnement et l'espace qualitatif: vers un modèle de représentations éphémères. Paris: Thèse de doctorat, Ecole Polytechnique.

Harnad, S. (1990). The Symbol Grounding Problem. *Physica D*, *42* (1-3), 335-346.

Rosch, E. & Mervis, C. B. (1975). Family resemblances: Studies in the internal structure of categories. *Cognitive Psychology*, *7* (4), 573-605.