Varieties of Natural Concepts

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Abstract:

The concepts to be considered in this chapter are those that occur in everyday common human thought and language – the "natural history" of concepts in use. While many may appear to be constituted by similarity relations, which make them suitable for modelling in conceptual spaces for example, other concepts in everyday use may be differently constituted. These concepts include abstract concepts, essentialist kinds, natural kinds, and logical or mathematical concepts. I discuss the different sources, uses and epistemological bases of these different forms of concept, and propose a three-level hierarchy of concepts based on their sources of validation.

1. Natural concepts

The domain of natural concepts will be taken here to be the cognitive representations that underlie the meaning of substantive words in any human language. This domain of everyday concepts, known in psychology as Semantic Memory (Tulving, 1972) is diverse and complex. Concepts can be highly technical and precise (as in many natural sciences, legal or engineering terms) or they can be used in everyday conversation to recount stories, debate issues, or express opinions. They can carry strong emotional or attitudinal content (Williams, 1985), or they can just be names for classes of entities. They can have explicit definitions, or they can just rely on custom and practice for how they are used. Concepts of course are also involved in many non-verbal behaviours such as judgment and decision making, perceptual recognition and memory for experienced events.

The primary focus of this chapter will be on lexical concepts – the terms with meanings which you will find "defined" in a dictionary of your language. As Sperber and Wilson (1998) argue, there are almost certainly many more concepts than there are word meanings. Lexical concepts are however an obvious place to begin when trying to discover what concepts are like and how people use them. Nonetheless, as we shall see, the term concept has also been used for learning based on purely perceptual non-verbal features, and even for categorization learning in non-human species.

The aim of the chapter is first to provide a broad review of how concepts have been understood and researched within the field of cognitive psychology. (For excellent reviews see Laurence and Margolis, 1999, Machery, 2009, and Murphy, 2002.) In a second section I will present a tripartite account of concepts, within which some of the philosophical debates on concepts (for example the problem of "error" or the controversy between externalist and descriptivist theories of concepts) can be placed in context. I argue that such arguments can be partly resolved by recognizing the different sources of validation upon which concepts depend, leading to at least three different ways in which concepts can be "right or wrong". A final section reviews a selection of empirical results from my lab over the course of a long career investigating the prototype theory of concept representation.

2. Some history

Since its origins in Ancient Greece, one of the major aims of philosophy has been to clarify and define the meaning of terms. Classification taxonomies have been developed for defining classes and subclasses, and it is this notion of a *Definition* that has been central to the history of concepts. A definition can itself be defined as a function or rule that takes a set of predicates or properties and yields a truth-value or classification decision. Concepts (following Frege, 1948) have two inter-related sides – the set of things to which they refer, and the set of properties that determine what falls in that set (what "falls under the concept"). Definitions determine what things fall under the concept by specifying what properties they must have.

Definitions are an excellent way to make concepts easy to use in reasoning and decision making, and to make them easy to teach. Take a legal example such as the crime of receiving stolen goods. As a judge explained to us, when I was serving on a jury in a court in London,

to find the defendant guilty of this crime, the jury must be sure that all the following propositions are true:

1) The accused was in possession of the property in question,
2) The property had previously been stolen,
3) The accused knew that the property had been stolen.

The legislature codifies the concept of each class of crime by specifying the conditions under which a jury may decide to convict. In this case the concept has a conjunctive rule with three necessary elements. If all three are judged to be true, based on the evidence presented, then that is sufficient for a decision of guilt. Legal systems necessarily employ definitions to reduce vagueness and uncertainty in transactions between people or organizations. There are regulations covering multiple aspects of life and action, all based on defined concepts.

One of the ground-breaking psychological studies to investigate conceptual reasoning using this notion of concepts as classification rules, was a book by Bruner, Goodnow and Austin (1956), which reported empirical tests of how people develop strategies for discovering different kinds of classification rule. Students were shown a 9 x 9 array which contained 81 visual stimuli differing on 4 different dimensions, with 3 possible values on each. They might be told that a particular stimulus was in class A, and they could then choose other stimuli to ask about. The participant's aim was to find the rule of what makes something an A. It was also explained to them what kind of rule they were looking for, such as a conjunction of necessary features, or a disjunction of sufficient features.

A successful strategy for conjunctions might proceed by changing just one dimension of the first example to discover if that dimensional value was a necessary feature or not. More adventurous participants could change two dimensions at once, in the hope that the new case would still be an A, thus allowing both dimensions to be ruled out in one step. (This move carried the risk that the new case would not be an A, in which case they would not know which dimension(s) were the critical ones.) Bruner et al. investigated different classification rules – conjunctive, disjunctive and relational, and showed that conjunctive rules tended to be the easiest to discover. In fact, it seems that by default we expect natural concept categories to have a conjunctive definition of a set of individually necessary and jointly sufficient features. This rule became known as the "classical" theory of concepts (Rosch, 1978).

Following from this research, the information processing revolution in Cognitive Psychology in the 1960s led to research into decision-based models of concept learning, exploring the formulation, testing, and reformulation of hypotheses (Hunt, 1962)

In contrast to the cognitive approach to concepts taken by Bruner, Hunt and others, the psychology of classification itself has a longer history in the experimental study of animal behaviour. Both Pavlov and Skinner studied how animals learn to discriminate different environmental contexts (Davey, 1981). Pavlov demonstrated how if a given stimulus was a conditioned stimulus (CS) that predicted the arrival of an unconditioned stimulus (UCS), as when a bell signalled the arrival of food to Pavlov's dogs, then the response (salivation) would generalise to other stimuli depending on their similarity to the CS (i.e. the tone of the bell). Similarly, in Skinnerian conditioning, if presentation of a visual stimulus S+ is used to indicate to a pigeon that pecking a key will lead to a food reward, then the likelihood of the animal pecking the key to some novel stimulus is driven by similarity to the S+. Other stimuli (S-) which indicate that pecking the key will lead to a time-out in which no food can be

acquired lead to suppression of responding. In this way conceptual classes can be trained in rats, pigeons, and other animals, on the basis of a dimension of similarity.

Detailed mathematical theories were developed (Bourne & Restle, 1959) to capture "concept identification" in animals and human subjects. Research in this tradition has continued to generate fascinating results (Wasserman, 1995; 2016; Weir, 2017) revealing, for example, how some pigeons can learn through extensive training, to categorise facial expressions in unknown humans, or to detect the presence of cancerous tissue in X-rays at a level on a par with human pathologists.

In 1961, another seminal study by Shepard, Hovland and Jenkins (1961), began a long tradition of studying how people (mostly undergraduate students) learn concepts by being presented with sets of exemplars of different categories. Typically, a participant is shown one stimulus at a time, decides which one of two or more categories it belongs to, and is then told if they are right or wrong. Once they have worked through the exemplar set, they then see them all again in a new random order, block by block, until, through a process of trial and error, a criterion level of success is reached (or not). New test items are then introduced in a final test block to diagnose what the individual has learned about the classification.

After much research it appears that, depending on whether there is a simple rule or not, individuals in such studies fall into three groups (Mathews, Stanley, Buss & Chin, 1985). Some generate hypotheses (as in the earlier Bruner research) which they test as new exemplars appear. Others prefer to memorize the membership of different exemplars and use similarity to these when faced with new items in the test session. And a third group fail to learn anything at all.

A review of category learning (Ashby & Maddox, 2005) concluded that there are "dramatic differences in the way people learn perceptual categories" (p. 149). Rule-based tasks and exemplar learning use very different cognitive processes, and can be differentiated in terms of learning context and brain regions involved. Similar two-process accounts are popular in a range of cognitive behaviours (Evans, 2003; Kahneman, 2011; Sloman, 1996; 2013).

Interestingly, it was originally a study of learning to classify abstract shapes that introduced the notion of a prototype, which was to become a central theory of semantic concepts. Posner and Keele (1968) wanted to test the learning of concepts based on pure perceptual similarity. To this end, they created categories consisting of a pattern of 9 dots distributed at random on a plain background. One such pattern was designated as prototype A, and another random pattern as prototype B. Other patterns were then designated as belonging to class A or class B simply as a function of which of the prototypes they were more similar to. People found this task relatively easy providing the two prototypes were well separated, and providing the novel patterns were not too far distorted from one or other of the prototypes. In fact, even if people never saw the actual prototypes in training, they were easily able to classify them in a later test session. The ease of learning this type of prototype concept based on similarity to a central case is strongly contrasted with the difficulty that people typically have with finding a logical rule for prototype categories – for example that Class A has at least two out of three given features (Dennis, Hampton, & Lea, 1973).

It was Rosch and Mervis in a series of important papers in 1975 and 1976 who applied the idea of a prototype to the exploration of "natural" concepts such as fruit, sport, or furniture

(Rosch & Mervis, 1975). Wittgenstein (1953), in a famous passage, argued that many of our concepts, such as GAMES showed a "family resemblance" structure such that different instances appeared to share many common features with others, even though no classical definition could be given. While it is unlikely that Wittgenstein himself intended this to be a theory of universals (Pompa, 1967), psychologists quickly seized on the idea of prototypes as providing an explanation for a range of empirical results concerning how people actually categorize the world. The development also coincided with the development of neural network and machine learning models in AI, which can be trained to categorize based on extensive training, either by detecting rules, or by learning prototypes.

I return to a discussion of prototypes in the final section. But first I present a rather speculative account of the evolutionary tree of concepts in human culture.

3. **Conceptual Evolution – a Hierarchy**

I propose that natural concepts evolve within a culture subject to selective pressures from three different sources. First, the physical (and social) reality in which we live, second the social/linguistic world that we are part of and interact with, and third our specific and idiosyncratic personal experience of our environment. Concepts at the first of these levels are likely to be learned through explicit learning in school. The second level develops as we engage in conversations, read texts, and learn to use and understand the symbols that constitute a language. The third level develops from a pre-conceptual base of uncategorized experience.

These conceptual levels do not always follow a clear or clean classification. Rather, concepts evolve within a culture to serve different purposes, and they may often show flexibility in taking different roles in different contexts. However, at all levels, concepts will have intensional content that determines reference (the extension of the concept), and all levels may have type hierarchies. The top level aims for strict class inclusion hierarchies, while the second level more often relies on default inheritance hierarchies of fuzzy sets.

3.1 Concepts grounded in the real world

Concepts at the top level (physical and social reality) are what we defer to when experts (be they biologists, physicists, or social scientists) create specialised concepts with which to explain and understand the world around us. They tell us that whales and bats are both mammals, , while penguins and ostriches are birds, despite the minimal apparent similarity within each pair. They tell us that appearances are often misleading, and that deeper reasoning can explain why.

Top level concepts are often those taught in schools and colleges and used in technical areas of expertise. They have been developed over centuries and millennia of cultural development by scholars and intellectuals and represent the accumulated cultural capital of a society. They capture "common sense" but also go beyond it. Concepts in this domain have definitions which aim not only to provide a taxonomy of classes in the world, but also to build a web of belief (Quine, 1970) where each concept plays a role relative to others to build theories, make predictions, or decide on effective action. According to one view, a person can have the "wrong concept" at this level if their concept includes intensional beliefs for which there is counterevidence, or if it fails to refer to the correct class in the world. To take a familiar example, if I believe that snakes are slimy, I have the wrong concept

of snake (even though I can correctly identify them), or if I believe spiders are insects, I must have the wrong concept of spider, the wrong concept of insect or both.

Top level concepts are the natural habitat for externalist semantics (Fodor, 1998; Kripke, 1980; Putnam, 1975). Rather than having the wrong concept of snake if I believe they are slimy, this view argues that in fact I have the right concept of snake – it is the concept that correctly points to the class of things in the world that are called snakes. It is in my beliefs (my cognitive intension) *about* snakes that the error lies. This argument does not rule out the possibility that one can have wrong concepts, but it explains how it is possible that many disagreements involve facts (beliefs) about agreed categories, rather than disagreements about the correct way to categorize the world. Believing that spiders are insects (as many undergraduate psychology students appear to believe), is simply a false belief, but it does not imply that the concepts of spider and insect held by the individual are "wrong".

In this light, many concepts at this top level are *discovered* through empirical research and the construction of theory to explain those research findings. Differentiating the concepts of inertial mass and weight mass, or of heat and temperature did not come easily. Naïve notions of physics (Vosniadou, 2002) come naturally to children as they develop, but need to be restructured through extensive education if the children are to have a correct understanding of how the physical world works.

Definitions in science and other technical fields aim to be precise and transparent. Given an object with a certain mass and velocity, momentum is their product, whereas kinetic energy is half of mass x velocity squared. As areas of knowledge develop, concepts and their definitions may be created and agreed by convention or may be stipulated by their originator. The well-known reclassification of the planet Pluto as a "dwarf planet" was arrived at via a vote of the International Astronomical Union in 2006, thus changing both the definition and the reference of the term "planet" in astronomy.

At the fringes of the top level are concepts being developed in areas where knowledge is still far from complete, and good theories are lacking. Medical and biological sciences contain many domains where concepts are fragile and subject to constant revision. In psychiatry and clinical psychology, the achievement of an agreed taxonomy of mental disorders is still a long way off (Tilmes, 2022). Concepts of this kind need to be embedded in theories if they are to function well to explain symptoms and drive remedial treatments, and until a discipline has a good working theory, its concepts must also be vulnerable to replacement.

3.2 Concepts grounded in the Social World

The social world also has concepts with definitions – particularly in the areas of legislation and documented social conventions. As the earlier example of the instructions given to a jury shows, it is central to the working of a legal system that the basis for decisions can be made as precise as possible. As anyone who has had dealings with bureaucratic institutions can relate, the rules are the rules, and they determine what happens. Defined terms include legal tender, kinship and marital status, gender and sex, obligations to pay taxes, professional qualifications to practice law or medicine, the charitable status of institutions, and vehicles that are permitted on the public roadway. (In 2023, the House of Commons in the UK were particularly concerned with the definition of a "party" as opposed to a "work

event" in the context of lockdown laws during the Covid-19 pandemic, leading to the resignation of the prime minister of the time).

At the same time, "rules are made to be broken" is an adage often applied to socially derived concepts, because, unlike the physical world, it is usually impossible to foresee all possible circumstances in which the application of the rule would either be under-determined or would lead to clearly unjust conclusions. Each invention of some new circumstance (such as electric scooters on city streets) requires the rules to be updated – just as the rules of sports like rugby are regularly changed to improve the game's safety and fairness. Note how small incremental changes in the code do not threaten the identity of the game. On the other hand, when Ellis Webb, a student at Rugby School, famously picked up a soccer ball and ran with it, a new game concept had to be created. Concepts in the social world can retain their identity through small continuous changes over time, just as a person or an object does.

The concepts that underlie the meanings of most substantive words (words that name or refer to objects, actions, qualities and so forth) fall in the realm of social concepts. The words which refer to "natural kinds" with top-level reference-determining concepts are relatively rare in everyday life and conversation. Even terms for biological kinds or medical conditions often have soft or vague meanings used in everyday speech without deference to their technical concept meanings. Thorne et al. (2021) investigated several concept domains, including professions, health conditions, recreations, and edible fresh produce. They asked people to rate 40 concepts belonging to each category on eight scales reflecting how reliable and useful the individual concepts were – how much information did the concept term convey, and how well did they understand it. In all the domains there was a common factor of how well understood concept terms were, ranging from common well-known concepts (e.g. sneeze or banana) to less well-known (e.g. colitis or pomegranate). In addition, the scales clustered around a notion of reliability and informativeness. Within any concept domain, some concept terms are considered very informative and useful, while others are vague and weakly defined. This wide range of informativeness is evidence for the three levels of concepts for which I have argued. A single concept term may have a clear definition for the purposes of legal or scientific use but may also have an "everyday" meaning that is determined not by facts of the physical world, but by facts about how language is used in one's social environment.

Concepts in the social world are the most likely to be of interest to philosophers and social scientists engaged in "conceptual engineering" (Cappelen, 2018). Concepts of social groups with which one has little contact are likely to be acquired from listening to others' opinions, reading articles in the media, social media posts and so forth, all of which can serve to perpetuate prejudicial concepts.

3.3 Personal concepts

I will not have much to say about personal-level concepts, except to point out the necessity of their existence. The proposal is that we can entertain personally defined categories which owe allegiance to neither the real world nor to the social world. I may choose to create a clustering or set in my knowledge representation that is unique to me, or such clusters may simply strike me. They are mine alone and not shared or copied from others. Such a proto-concept may be perceptually defined, for example a quality of the taste of wines, or particular kinds of walking gait that different people adopt, or situationally defined (a class

of situations with particular causes, feelings, or consequences) or anything else. Those personal concepts that have the capacity to linger in memory, to serve a useful function, and to be recalled on future occasions are likely to help drive my actions and choices, and I may even provide a name for them for myself or when explaining them to other people. In time, others hearing the name and seeing how it is applied will acquire the concept for themselves, and in this way new concepts enter the arena of social communication.

Some writers and thinkers are the source of many of our concepts. Apparently, William Shakespeare used 1700 words in his writings that had not appeared in print before, including common terms like *bandit, critic, dwindle,* and *lonely.* The human mind can create new concepts – for amusement, for commercial reasons, artistic reasons, or indeed for scientific reasons. Presumably all human concepts must have started this way.

4. **Prototype Concepts**

Much research since 1971 has been devoted to the exploration of what have been called Prototype Concepts (Rosch & Mervis, 1975). Using a term from Ryle (1949), we had first termed these Polymorphous Concepts (Dennis et al. 1973), but "prototype" is a better term, suggesting as it does the phenomenon of "prototypicality" or "typicality". Following on from Rosch's model, the use of prototype accounts was quickly identified in many academic disciplines, including linguistic syntax, philosophy of mind and action, social theory, and medicine. For an account of how prototype structures emerge naturally from normic laws of cultural evolution see Schurz (2012; 2021)

Prototypes play a prime role in lexical meaning. They evolve to serve a practical function, and so must be stable, and easy to learn and understand. One key assumption underlying prototypes is that they represent concepts by their *central tendency* rather than by their boundary conditions. It is usually very simple to categorize *typical* members of a category such as FRUIT or SPORT but much harder to decide about borderline cases. Consequently, semantic categories based on prototypes often show vagueness. Prototypes are an abstraction of the common elements and characteristics of members of the class. For the most part, they are collections of intensional properties, rather than individual exemplars, and as such can represent empty classes (*unicorns, talking mice)* as easily as those in the real world (Hampton, 2006).

A second key assumption is that prototype categories are based on similarity, broadly conceived. An object will belong to a concept class if, and only if, its similarity to the class is sufficiently high. What is meant by similarity here? For Rosch and Mervis (1975) it was the family resemblance of an object to the other objects in the class, calculated by summing the matching features (cf. Tversky, 1977). For Hampton's threshold model, (Hampton, 2007) it is the degree to which the object possesses the features that constitute the prototype representation, weighted by the salience or importance of those features. The evidence shows that for many semantic categories the scale of "degree of membership" and the scale of "typicality as a member" are related to the same underlying degree of similarity. As an item approaches a concept in similarity, so it becomes more similar until it reaches a boundary area where its membership degree starts to grow. Once membership is clear, then typicality will continue to increase as the similarity gets yet higher. In this case, Hampton (1998) showed a clear difference between biological "natural kind" terms like FISH and artifact terms like FURNITURE. Whereas the latter concepts show a smooth curve linking

membership and typicality, natural kind terms can show a dissociation between them with items to be considered as FISH like WHALE being more typical as FISH than they are members, and items like SEAHORSE being better members than they are typical. In this case people are willing to defer to biological categories when judging class membership but revert to similarity-based prototypes for judging typicality. A corresponding difference between natural kind and artifact terms was also shown in Hampton et al. (2009). The probability of being classed in an artifact category drops in a linear fashion as central features are changed. As the features of a building were changed from those of a church to those of an art gallery, the probability of being categorized as a church and the probability of being categorized as an art gallery tended to sum to one. The same was not true for biological kinds. As one type of animal was imagined as possessing some features of a different animal, the chimeric creature was only reluctantly accepted in either category.

To give some more detail, current thinking on prototypes highlights four key phenomena (see Hampton, 2006).

4.1 Opacity

As Wittgenstein (1953) famously noted, it is difficult to provide a clear definition of terms like GAME. When concepts have prototype representations, then people can readily tell you what features are relevant to being in the class, but they cannot use those features to provide a classical definition using necessary or "defining" features alone. Terms like FRUIT, DEPRESSION or PLANET (until recently) are typically defined by providing a list of characteristics commonly understood to justify the application of the term. In my PhD thesis research (Hampton, 1979) I interviewed participants in depth about the definition of eight category terms, using a set of seven different questions. Only half of the concepts proved to have defining features which could provide a necessary rule for category membership. Moreover, people were unable to point out which features were defining. In fact, Armstrong, Gleitman and Gleitman (1983) found that people are generally over-optimistic in believing that common category terms have clear definitions, an effect that mirrors Rozenblit and Keil's (2002) illusion of explanatory depth in showing poor metacognitive awareness of the limits of one's own understanding.

4.2 Vagueness

In philosophy, vagueness is usually discussed in terms of the Sorites Paradox. Attempting to use a continuous scale, such as size, as the basis of a sharp binary distinction (as whether an amount of sand is a heap, or not a heap) leads to this well-known paradox. If you remove the sand from a heap, one grain at a time, at what point does it suddenly switch from heap-hood to non-heap-hood? In a similar fashion, category membership in nominal categories often shows vagueness. Two measures of vagueness can be shown to correlate (McCloskey & Glucksberg, 1978). On the one hand people disagree about membership in a category, leading to items with probabilities of categorization across the full range from zero to one. On the other hand, those same vague items show poor test-retest reliability when people are asked sometime later to classify them again. While within-person consistency is generally better than between-person agreement, both measures provide good evidence that the reference of terms like FRUIT or WEAPON is vague.

An interesting issue concerning vagueness relates to whether there is a well-defined "borderline region" where vague items are to be found. Using the ideas of

supervaluationism, Kamp and Partee (1995) suggested that there could be three truth values for a category membership proposition. An item may be a clear member (TRUE), a clear non-member (FALSE) or have an ill-defined status (NEITHER TRUE NOR FALSE). This proposal led to the question of whether it is any easier to decide if something is a *clear* member or *clear* non-member of a category than to simply decide if it is in the category or not. The idea was that if Kamp and Partee were right, then people should be more consistent in deciding on *clear* versus *unclear* cases than on membership itself. In the event, it turned out that this second-order vagueness was of exactly the same magnitude as first-order vagueness for categorization and for a range of other kinds of personal judgments. There was no evidence for a sharper boundary around the items judged to be clear members or clear non-members (Hampton et al., 2012). In contrast, and as a control, being able to differentiate clear from uncertain answers did lead to greater consistency when making decisions about true or false general knowledge statements.

4.3 Typicality

Rosch and Mervis (1975) introduced the idea of *typicality,* and it has since proved to be a highly predictive variable across a wide range of psychological measures, including decision times, inductive reasoning, and memory. At times typicality has been dismissed as a purely "psychological" dimension, meaning that it reflects associations, frequency of use, and other measures linked to the use of concepts independent of their structure or content. It is worth noting that finding degrees of typicality in a category of items does not provide any evidence that the category is not well-defined. As Smith, Shoben, and Rips (1974) pointed out, it may be the case that the features of a concept can be differentiated into *defining features* which determined category membership, and *characteristic features* which determine typicality. Perhaps unfortunately, they relied for their argument on the concept of BIRDS which do show this structure. Birds are biologically quite distinct as a class, and have several necessary defining features, together with others which are only true of typical birds. (Research has shown that birds are exceptional in this respect.) Another problem is that typicality in real-world categories is correlated with familiarity and other dimensions (Barsalou, 1985; Hampton & Gardiner, 1983; Malt & Smith, 1982.

Having a classical definition does not preclude having a typicality structure. There can be more or less typical cases of a given crime, and more or less typical British citizens. Therefore, evidence from typicality is not particularly relevant to the question of whether a concept is prototype-based (Armstrong, Gleitman, & Gleitman, 1983).

4.4 Genericity

Many of the propositions that people accept as true in everyday language are true in a generic rather than a literal or universal sense (Leslie, 2007). Statements such as "Potatoes contain Vitamin C" or "Tigers have stripes" are true regardless of the existence of counterexamples. The literature on genericity is large, and I do not intend to approach it here. The point to be made is that if we represent concepts as clusters of correlated attributes, without much concern for precise boundaries, then genericity follows as a simple corollary (Hampton, 2012). We do not normally think of concepts in terms of class inclusion or universal quantification except when circumstances demand it (for example, when we need to use top-level concepts for financial or regulatory purposes). When people agree that a chair is a type of furniture, they do so because they see the features of chairs as matching a sufficient number of the features of furniture. They are found in homes, provide comfort,

can be moved around, are artifacts and so on. When they are then asked whether a child's car-seat is a type of chair, once again they agree that it is, since the object has a back and a seat, and provides support for sitting. However, they do not typically allow that the car-seat is furniture. At no point does it strike us that there is a logical fallacy here, yet we have agreed that A is a type of B, B is a type of C, but that A is not a type of C (Hampton, 1982).

This kind of "non-logical" reasoning is also evident in logical combinations of concepts. Over several studies, reviewed in Hampton (2018), I explored relative clause conjunctions (*a sport which is a game),* negated relative clause conjunctions *(a sport which is not a game)*, nominal compounds *(school furniture*) and disjunctions *(something that is either a fruit or a vegetable).* In every case there were clear violations of logical rules that one would expect to apply. Asked if a lift (elevator) is a vehicle, 54% agreed, but when another group was asked if a lift is a machine that is also a vehicle then 82% agreed. Desk lamps are judged to be furniture by 80% of participants, but a different 74% agreed that a desk lamp was a household appliance that is NOT furniture. For disjunctions, 50% agreed that a mushroom was either a fruit or a vegetable, whereas only 10% thought it was a vegetable, and no one thought it was a fruit (even though, paradoxically, that is what it is!)

These results strongly suggest that people are thinking *intensionally* as Tversky and Kahneman (1983) term it. People do not consider the set overlap of two concepts when judging a conjunction. Instead, they try to form the set union of the features from the two concepts in question. For a *pet fish* (a classic case used to argue against prototypes, Fodor & Lepore, 2002; Osherson & Smith, 1981) the union of features will include (from the fish prototype) swimming in water, having gills, living in lakes rivers or oceans, and being eaten with chips, and from the pet prototype, it will include having an owner, needing to be fed, and being cuddly and affectionate. Combining these sets into a coherent concept means eliminating features from each side. Pet fish do not live in oceans and are not eaten with chips. Nor are they warm and cuddly or affectionate. The result is a new composite prototype for PET FISH which differs in important ways from the original conjuncts. When judging membership or typicality in the conjunction it is then quite to be expected that some items will have greater reason to belong in the conjunction than in one (or even both) of its conjunct concepts (Storms et al. 1998).

5. **Conclusions**

Concepts live in an ecosystem. They originate in people's creative consciousness as they seek to find new ways to describe, understand and appreciate the world around them. That world contains external physical domains, external social and linguistic domains, and internal psychological domains. The social world, and in particular the use and development of a conceptual vocabulary within any given linguistic community, leads to the selection of concepts that best serve the many different functions that concepts provide us with. They may serve the function of classifying entertainment and recreation with categories of music, drinks, films, or restaurants, or provide us with fantastic creations such as ORCS or UNICORNS. They may serve a transactional/social function as in commerce, regulation, finance, or legislation. And they may serve a function of improving our lives as lived in the physical environment, with concepts of medicine, engineering, energy, and wild eco-systems.

Given the wide range of functions that concepts serve, it is unreasonable to expect them to have a common structure. Even the concept of "concept" itself can serve different functions, and so have different definitions. For an externalist philosopher, CONCEPT fulfils the function of determining reference and hence underpinning a symbolic compositional theory of mind, something that it can do even without concepts having intensional content (Fodor, 1998). For a social scientist, concepts capture the different ways in which societies are organized, how different social groups form and how they are related to each other in many different ways. For the cognitive psychologist, concepts explain people's reasoning, memory, prejudices, and behaviours across a range of social and individual behaviours.

Rather than abandoning the concept of CONCEPT, as Machery (2009) has proposed, it is more fruitful to suggest that there are many varieties of natural concept, and that these varieties are not mutually exclusive sets. Concepts that begin as similarity clusters appearing in one individual's experience with prominent exemplars can develop into named prototype informational structures based on features that are shared within a linguistic community. Research into the nature of these prototypes can then lead to definitional concepts forming part of an explanatory theory. Concepts can evolve, moving up or down the hierarchy depending on how they seek validation. As science and scholarship have developed, so some top-level concepts have been relegated or even lost, while others have been redefined in drastic ways. As individuals come up with new ideas like fashion styles or new types of music, so their concepts get developed until their names are sufficiently well known that they enter the linguistic lexicon. After that they may shift and evolve further as the constantly changing world of fashion moves on.

For last year's words belong to last year's language
And next year's words await another voice.

T. S. Eliot (1943) "*Little Gidding", Four Quartets.*

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