Origins of Mind: Lecture 04

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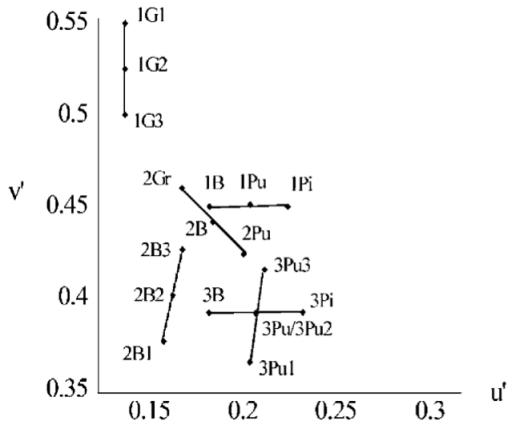
1. Categorical Perception of Colour

What is categorical perception of colour commonly taken to explain? The diagram below represents sequences of three colours. The vertical sequence shows three greens and the uppermost horizontal sequence shows a blue, a purple and a pink.



Daoutis et al. 2006 figure A1

Each colour differs from its neighbours by the same amount according to a standard measure based on the human eye's abilities to discriminate wavelengths.

Yet the greens are often judged to look quite similar and the blue-pink-purple to look very different (Roberson et al. 1999, p. 12–7). When people are asked to name these colours, they often give the same name to the greens but different names to members of the blue-pink-purple sequence. And people are generally faster and more accurate in discriminating between members of the blue-pink-purple sequence than members of the green sequence (faster: Bornstein & Korda 1984; more accurate: Roberson et al. 1999, p. 22–7).

pop-out 'Such targets pop out of the display, so that the time it takes to find them is independent of the number of distractors' (Treisman 1986, p. 117).

When target and distractors differ in colour category there can be pop-out effects (Daoutis et al. 2006).

A process is *automatic* just if whether it happens is independent of the subject's task and motivation (to a significant degree)

vMMN (visual mismatch negativity): an event-related potential thought to index pre-attentive change detection in the visual cortex

2. Categorical Perception in Infancy

Categorical perception of colour emerges early in infancy. This has been demonstrated with four-month-olds using habituation (Bornstein et al. 1976) and visual search (Franklin et al. 2005).

Slightly older infants can make use of colour properties such as red and green to recognise objects.

For instance, nine-months-olds can determine whether an object they saw earlier is the same as a subsequently presented object on the basis of its colour (Wilcox et al. 2008).

By the time they are two years old, toddlers who do not comprehend any colour words can use colour categories implicitly in learning and using proper names; for instance, they are able to learn and use proper names for toy dinosaurs that differ only in colour (Soja 1994, Experiment 3).

So infants and toddlers enjoy categorical perception of colour and may benefit from it in recognising and learning about objects.

However children only acquire concepts of, and words for, colours some time later; and colour concepts, like colour words, are acquired gradually (Pitchford & Mullen 2005; Kowalski & Zimiles 2006; Sandhofer & Smith 1999; Sandhofer & Thom 2006).

2.1. Other cases

Infants enjoy categorical perception not only of colour but also of orientation (Franklin et al.

2010), speech (Kuhl 1987, 2004; Jusczyk 1995) and facial expressions of emotion (Etcoff & Magee 1992; Kotsoni et al. 2001; Campanella et al. 2002).

3. Categorical Perception and Knowledge

Categorical perception provides 'the building blocks—the elementary units—for higher-order categories' (Harnad 1987, p. 3).

'The building blocks of all our complex representations are the representations that are constructed from individual core knowledge systems.' (Spelke 2003, p. 307)

'The module … automatically provides a conceptual identification of its input for central thought … in exactly the right format for inferential processes' (Leslie 1988, pp. 193–4)

Acquiring colour concepts depends on acquiring colour words (Kowalski & Zimiles 2006).

'the course of acquisition for color is protracted and errorful' (Sandhofer & Thom 2006)

'the earliest conceptual functioning consists of a redescription of perceptual structure' (Mandler 1992)

Colour words shape adults' categorical perception (Roberson & Hanley 2007; Winawer et al. 2007).

Categorical perception provides 'the building blocks—the elementary units—for higher-order categories' (Harnad 1987, p. 3).

A Conjecture 'humans acquire knowledge at a pace far outstripping that found in any other species. Recent evidence indicates that interpersonal understanding—in particular, skill at inferring others' intentions—plays a pivotal role in this achievement.' (Baldwin 2000, p. 40)

'functions traditionally considered hallmarks of individual cognition originated through the need to interact with others … perception, action, and cognition are grounded in social interaction.' (Knoblich & Sebanz 2006, p. 103)

Vygotskian Intelligence Hypothesis: 'the unique aspects of human cognition … were driven by, or even constituted by, social co-operation.' (Moll & Tomasello 2007, p. 1)

'human cognitive abilities … [are] built upon social interaction' (Sinigaglia & Sparaci 2008)

4. Core Knowledge

For someone to have *core knowledge of a particular principle or fact* is for her to have a core system where either the core system includes a representation of that principle or else the principle plays a special role in describing the core system.

4.1. Two-part definition

'Just as humans are endowed with multiple, specialized perceptual systems, so we are endowed with multiple systems for representing and reasoning about entities of different kinds.' (Carey & Spelke 1996, p. 517)

'core systems are largely innate encapsulated unchanging arising from phylogenetically old systems built upon the output of innate perceptual analyzers' (Carey & Spelke 1996, p. 520).

Note There are other, slightly different statements (e.g. Carey 2009).

4.2. Compare modularity

Modules are 'the psychological systems whose operations present the world to thought'; they 'constitute a natural kind'; and there is 'a cluster of properties that they have in common' (Fodor 1983, p. 101).

These properties include:

- domain specificity (modules deal with 'eccentric' bodies of knowledge)
- limited accessibility (representations in modules are not usually inferentially integrated with knowledge)
- information encapsulation (modules are unaffected by general knowledge or representations in other modules)

– innateness (roughly, the information and operations of a module not straightforwardly consequences of learning; but see Samuels (2004)).

4.3. Objection

'there is a paucity of … data to suggest that they are the only or the best way of carving up the processing,

'and it seems doubtful that the often long lists of correlated attributes should come as a package' (Adolphs 2010, p. 759)

'we wonder whether the dichotomous characteristics used to define the two-system models are … perfectly correlated … [and] whether a hybrid system that combines characteristics from both systems could not be … viable' (Keren & Schul 2009, p. 537)

'the process architecture of social cognition is still very much in need of a detailed theory' (Adolphs 2010, p. 759) (Carey & Spelke 1996, p. 517)

5. Appendix: Categorical Perception in Infants and Adults (Optional)

In adults, categorical perception of colour disappears in the face of predictable verbal interference but not non-verbal interference (Roberson & Davidoff 2000; Pilling et al. 2003; Wiggett & Davies 2008).

'surprising it would be indeed if I have a perceptual experience as of red because I call the perceived object 'red'' (Stokes 2006, pp. 324–5)

There is evidence that the infant mode of categorical perception of colour continues to operate in adults, although it is often inhibited or overshadowed by the adult mode (Gilbert et al. 2006).

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