Coloured thinking

JULES DAVIDOFF *delivered the C.S. Myers Lecture at the 2004 Annual Conference.*

CHARLES Myers became one of the founding fathers of British psychology (see Costall, 1998) as a result of going on an expedition to the Torres Straits (off New Guinea) organised from Cambridge University. As Richards (1998) wrote, 'for Myers the Expedition was an epochal experience, deciding him on a psychological career'. However, it is interesting to note the different outcome of that expedition for Myers (and also for Rivers, one of the founders of the BPS) compared with that for McDougall (also a founder of the BPS). McDougall, and hence perhaps his pupil Cyril Burt, saw evidence in their data for the genetic determination of cross-cultural cognitive differences. Myers, and hence perhaps his pupil Frederic Bartlett, saw the methodological impossibility of satisfactorily transferring experimental psychology from the laboratory to the field. Myers realised that their data were unreliable. As Richards wrote of the published work from the expedition, 'the Reports thus became a virtuoso exercise in the art of writing up unsatisfactory research as positively as possible short of outright dissembling' (p.145).

My own work on names and knowledge has to a great extent also been based on work in New Guinea, but in the hundred years that separate the two research enterprises it has become possible to conduct studies with the proper control that Myers realised was lacking in their work. To investigate the colour naming and memory of a remote people in New Guinea, my PhD student (Debi Roberson) used a solar-powered light box and computer to present stimuli under controlled conditions. Those studies showed that colour categories result from the colour terms in the speaker's language (Davidoff *et al.*, 1999; Roberson *et al.*, 2000).

Part of a more general debate about the relationship between language and thought, the question of whether the language available to describe the perceptual experience of colours can influence that experience is an intriguing one. Historically, the debate was characterised by the dichotomous views that thought (or, in our particular instance, colour) categories are either shaped by language (often called the Whorfian or linguistic relativity view) or completely independent of it (Berlin & Kay, 1969). Recent systematic investigations of the relationship between language and thought have provided evidence for both views, and the field of colour categorisation has provided a rich testing ground for the effects of language on perception.

Cultures and categories

While the physiological basis of colour vision is the same for all humans with normal trichromatic colour vision, there is considerable diversity in the way that different languages segment the continuum of visible colours. Some languages have been reported to use as few as two terms to describe all visible colours (Heider & Olivier, 1972). Others have been reported to use between three and eleven (Berlin & Kay, 1969). This variability exists just for those terms deemed by Berlin and Kay to be 'basic' (monolexemic, present in the idiolect of all observers and not subsumed within the meaning of other terms).

With Debi Roberson and Ian Davies, (Roberson *et al.*, 2000) I reported a series of experiments that set out to replicate and extend the work of Rosch Heider in the early 1970s (Heider & Olivier, 1972). Heider's experiments had been particularly influential in promoting the view that language and cognitive experience are largely independent (in some cases, orthogonal). We found substantial differences in perceptual judgements and memory performance between a language with 11 basic colour terms (English) and one with only five (Berinmo). Our results suggested that language not only facilitates memory performance but also affects the perceived similarity of perceptual stimuli.

WEBLINKS

Jules Davidoff's website: *tinyurl.com/6wkdh*

Debi Roberson's website: *tinyurl.com/4ctvc*

The kinds of experiments we carried out can be illustrated from a study in which we asked people to divide colour patches into two groups. To an English speaker, these could easily be classified as a green group and a blue group. To the Berinmo, who use the same word for the colours that we call green and blue, the classification was not obvious. There was no instinctive appreciation that blue and green were different categories. Then, using colour patches that crossed a boundary in their language, we were able to reverse the outcome. The English speakers, who used the same word for colours that crossed the Berinmo colour boundary, found it relatively difficult to learn the appropriate category for each colour patch whereas the Berinmo found the task relatively easy.

The cross-lingual research has been continued in our recent studies with the Himba in Namibia. Here we were able to follow the progress of children as they acquired colour names. Our previous research with adults mostly used memory errors as the main data to argue for linguistic relativity; however, what appeared to be errors particular to a language might merely derive from the participant using a verbal code to remember colours. So, language-based memory errors might not necessarily contradict the universal account of colour categories. However, these arguments against memory errors cannot apply to children who do not know colour terms.

The results showed that the pattern of memory errors was very similar in English and Himba children with no colour term knowledge. Crucially, neither pattern resembles that derived from the 11 basic categories of English. The errors were based on perceptual distance rather than a particular set of predetermined categories. Thus, before the child has acquired any colour terms there is no evidence of any innate categorical organisation.

Of particular interest was children's performance, as they acquired colour names, in their attempts to remember a navy blue which lies perceptually between the English prototype blue and black. For English speakers, this colour is, of course, in the same category as the prototype blue. For Himba speakers, however, it is in the same category (name) as black. Within the set of colour patches to be remembered, there was a closer perceptual alternative to the navy blue than either of these; this was purple. If choices were only influenced by perceptual similarity the purple should be a more frequent erroneous choice than either the prototype blue or the black, for both populations. In both populations of children, the errors made to the perceptually closer (purple) colour increased over the first two years of testing. Then, in the third year, as the children acquired colour names, the errors diverged. The English children confused the navy blue with the prototypic blue; the Himba children confused it with black.

Clues from neuropsychology

The impetus for the cross-lingual research into colour naming actually came from neuropsychology. The inability to carry out tasks requiring categorisation is a common consequence of aphasia (total or partial loss of the ability to use or understand language), and historically impairments on categorisation tasks were considered crucial to the debate concerning the relationship between impaired language and thought. Strong opinions were expressed in the early days of modern neuropsychological research: the argument was considered one of the most crucial in neuropsychology, surfacing many times in the subsequent 100 years. On the view that related aphasia to conceptual impairment, the two disorders have been seen variously to derive from a more general impairment in the use of symbols and from impaired abstraction and categorisation capacity (Goldstein, 1948).

The categorisation tasks employed by Goldstein were used in a few subsequent studies. For example, De Renzi *et al.* (1972) asked participants to sort skeins of coloured wool and found some (those unable to name and deemed to have anomic aphasia) were unable to do so despite normal colour vision. However, they concluded that the 'reason for aphasics' poor performance is not clear' (p.147). Impaired categorisation was also restricted to anomic aphasia by Caramazza *et al.* (1982), who commented that 'the strongest statement that can be made at this time is that the type of semantically based deficit we have uncovered appears to be associated with some types of posterior pathology, but not with all posterior lesions' (p.186).

A little more progress on clarifying the limits of categorisation in anomic aphasia was made by Roberson *et al.* (1999). In our examination of the conceptual abilities of a patient (LEW), we noted two contrasting patterns of performance. Whereas the patient was able to divide objects by some categorisation instructions, he seemed unable to do so and even bewildered by others. He excelled at sorting pictures of animals into those that were foreign and those that were British, but despite his excellent colour vision, acuity and otherwise excellent comprehension, he

struggled with perceptual categorisation tasks (sorting colours and facial expressions) into as many groups as he thought appropriate.

The apparently simple tasks of colour sorting completely defeated LEW unless the stimuli were arranged so that categorisation could be achieved by his intact perceptual (colour) discrimination. Thus if colour samples were presented for which the within-group similarity was much greater than the between-group similarity (i.e. narrow ranges of reds, greens, yellows and blues), he sorted them into four groups without error. Nevertheless, his performance was abnormal because he used a slow pairwise comparison for each stimulus; the colour groups did not 'pop-out'. His abject failure was for tasks where within-group colours had a wide range of lightness and saturation; in those situations, assessing visual similarity is extremely difficult. In any case, even if LEW could have computed visual similarity, it is not a procedure that would have resulted in normal colour categories. In terms of perceptual discrimination, a colour that we call pink could be closer to a colour we call yellow than to a colour we would call red.

HELDUR NETOCNY/PANOS PICTURES

The failure of LEW at perceptual categorisation tasks is extremely important and leads directly to the conclusion that it depends on language. To understand the connection, it is necessary to realise that the tasks which LEW could not do use continuous variables that fundamentally reduce the ways in which categorisation can be achieved. For such variables, purely perceptual categories are an impossibility because categorisation from continuously varying stimuli cannot be achieved solely by perceptual means.

If purely perceptual categories were possible, it would wrongly imply that colour is immune from what is classically known as the Sorites paradox. The paradox becomes apparent from a thought experiment. Suppose we alter a colour (say, one that we would call red) by imperceptibly reducing the wavelength. We would be forced to call the second colour by the same name (i.e. red). The process could then be repeated by again reducing the wavelength by an imperceptible amount. Again, we would have to admit that the third colour should be given the same name as the second. Continuing this procedure many times, one would have to finally, and paradoxically, admit that blue colours should be called red. The paradox can only be avoided by introducing some non-perceptual mechanism (e.g. names or rules) into the categorisation process. Thus, we would argue that colour categorisation is essentially a rule-governed procedure. Colours may be assigned to a category on the basis of similarity, but it is similarity to an arbitrarily defined (named) colour (see Roberson *et al*., 1999).

The inability of the patient to sort colours arises because of his inability to follow a rule- (name)-governed procedure. If one views colour naming as rule following, then we can more clearly see why it is language-based and therefore why different colour categorisation tasks are easy or difficult for the Berinmo, Himba, and indeed for us. Other types of naming task are different and are usually associated with lots of associated knowledge. For those tasks, one can use knowledge to accomplish the categorisation. Indeed, when LEW was asked how he sorted pictures of animals into those that were foreign, he pointed to the correct examples and said the one word 'Zoo'.

So we now believe (Davidoff & Roberson, 2004) that our cross-cultural research provides evidence for two distinctly different types of thinking: concrete vs. abstract. Future research should be of interest to a wide range of psychological practice.

■ *Jules Davidoff is Professor of Psychology at Goldsmiths College, University of London. E-mail: pss01jd@gold.ac.uk.*

References

Berlin, B. & Kay, P. (1969). *Basic color terms: Their universality and evolution*. Berkeley, CA: University of California Press.

Caramazza, A., Berndt, R.S. & Brownell, H.H. (1982). The semantic deficit hypothesis: Perceptual parsing and object classification by aphasic patients. *Brain and Language, 15*, 161–189.

Costall A. (1998). From the 'pure' to the 'applied': C.S. Myers and British psychology. *Revista de Historia de la Psicologia, 19*, 143–163.

Davidoff, J., Davies, I. & Roberson, D. (1999) Colour categories of a stone-age tribe. *Nature, 398*, 203–204; *402*, 604.

Davidoff, J. & Roberson, D. (2004). Preserved thematic and impaired taxonomic categorisation: A case study. *Language and Cognitive Processes, 19*, 137–174.

De Renzi, E., Faglioni, P., Scotti, G. & Spinnler, H. (1972). Impairment of color sorting behavior after hemispheric damage: An experimental study with the Holmgren Skein Test. *Cortex, 8*, 147–163.

Goldstein, K. (1948). *Language and language disturbances*. New York: Grune and Stratton.

Heider, E.R. & Olivier, D.C. (1972). The structure of the color space in naming and memory for two languages. *Cognitive Psychology, 3*, 337–354.

Richards, G. (1998). Getting a result: The Expedition's psychological research 1898–1913. In A. Herle & S. Rouse (Eds.) *Cambridge and the Torres Straits* (pp.136–157). Cambridge: Cambridge University Press.

Roberson, D., Davidoff, J. & Braisby, N. (1999). Similarity and categorisation: Neuropsychological evidence for a dissociation in explicit categorisation tasks. *Cognition, 71*, 1–42.

Roberson, D., Davies, I. & Davidoff, J. (2000). Colour categories are not universal: Replications and new evidence from a Stone-age culture. *Journal of Experimental Psychology: General, 129*, 369–398.