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Synaesthesi

Introduction

Synaesthesia is a curious condition in which an otherwise normal person experiences sensations in one modality when a second modality is stimulated. For example, a synaesthete may experience a specific colour whenever she encounters a particular tone (e.g., C-sharp may be blue) or may see any given number as always tinged a certain colour (e.g., ‘5’ may be green and ‘6’ may be red). The condition was first clearly documented by Galton (1880) who also noted that it tends to run in families. One problem that has plagued research in this field is that, until recently, it was not even clear that synaesthesia is a genuine sensory/ perceptual phenomenon (Baron-Cohen & Harrison, 1997; Cytowic, 1989; Harrison, 2001; Ramachandran & Hubbard, 2001a). Indeed, despite a century of research, the phenomenon is still s[(t.2(.816 TDty)-412.4ne)-1851.6(&ues.)[(51.W)8.2(.)[(51.hav(.)[(51.fr

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provide an experimental lever for understanding more elusive phenomena such as metaphor (Ramachandran & Hubbard, 2001a).

Finally, the idea that synaesthesia is a result of drug use is only applicable to a few people, and seems to occur only during the 'trip'. One explanation of this is

Synaesthetic Associations are Stable over Time

to determine whether a given feature is genuinely perceptual or not (Beck, 1966; Treisman, 1982). For example, tilted lines can be grouped and segregated from a background of vertical lines but printed words cannot be segregated from nonsense words or even mirror reversed words. The former is a perceptual difference ita

Cohen, 1997; Marks, 1997). However, it is usually stated in very vague terms and anatomical localization has not been properly investigated. Our goal here will be

the numbers alternating at a higher frequency. This ‘rivalrous’ phenomenon is difficult to explain on a memory or metaphor account of synaesthesia.

that the visual deprivation causes tactile input to start activating visual areas;
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Synaesthesia and Visual Imagery

arithmetic such as multiplication or subtraction. Remarkably, the subsequent colour areas in the cortical colour-processing hierarchy lie in the superior temporal gyrus, adjacent to angular gyrus (Zeki & Marini, 1998). It is tempting to postulate higher synaesthetes may require more focussed attention in order to experience their colours. This would be consistent with data supporting the idea that attentional gating is more effective at higher levels of the visual hierarchy (Moran & Desimone, 1985).

sensory-to-limbic connections the reward value of such mappings would also be higher among synaesthetes).[10]

divine intervention. More recently, even Chomsky, the founding father of modern linguistics, has expressed the view that, given the complexity of language, it could not have possibly evolved through natural selection.

Our solution to the riddle of language origins comes from synaesthesia. To understand this argument, we need to put together several ideas.

First, consider stimuli like those shown in figure 7, originally developed by

Iacoboni *et al.*, 1999). Most neurons in this area will fire when the monkey performs complex manual tasks (e.g., grasping a peanut, pulling something or pushing something). But a subset of them, mirror neurons, will fire even when the monkey watches another 'actor' monkey or human performing the same action. We can think of these neurons as doing an internal simulation of such actions.[13]

Another piece of circumstantial evidence for the notion of sensorimotor

Figure 8. A new synaesthetic bootstrapping theory of language origins.

Arrows depict cross-domain remapping of the kind we postulate for synaesthesia in the fusiform gyrus. (1) A non- arbitrary synaesthetic correspondence between visual object shape (as represented in IT and other visual centers) and sound contours represented in the auditory cortex (as in our bouba/kiki example). Such synesthetic correspondence co.7(gesdencerieco.7(gpase7(gesdencion)-262.6(iother)-262
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mimicry of the pincer-like opposition of thumb and forefinger to denote small size. Also, when pointing I use my index finger to point outward to you. I also produce a partial outward pout with my lips (as in English ‘you’, French ‘tu’ or ‘vous’ and Tamil ‘thoo’), whereas when I point inward to myself, my lips and tongue move inwards (as in English ‘me’, French ‘moi’ and Tamil ‘naan’) In this manner a primitive vocabulary of gesture and pantomime could evolve through synkinaesia into a corresponding vocabulary of tongue/palate/lip movements (causing vocalizations, especially if accompanied by guttural utterances).

We are suggesting that these factors provided the initial impetus for language evolution, not that all modern language is synaesthetic in origin. The subsequent elaboration and refinement of the deep structure of language may have relied on other environmental selection pressures and biological constraints unrelated to synaesthetic metaphor (and, indeed, was probably guided by offline, hierarchic, symbol manipulation as well as *semantic* constraints, mediated by influences from the Wernicke's area). It is, however, the *initial* emergence of a complex multi-component trait that usually poses a challenge for evolution through natural selection, and that is what we are trying to explain here. That is, our theory really pertains to the origin of *proto-language* rather than Chomskyan universal grammar, but we believe that given the pre-adaptation provided by proto-language, Chomskyan UG could have evolved more readily. Additionally, numerous thinkers (Bickerton, 1995; Devlin, 2000; Lieberman, 1992) have pointed out that syntactic structure may have arisen from the pre-adaptation provided by syllabic structure.

The key idea here is that each of these different effects (synaesthesia between object appearance and sound contour, between sound contour and vocalizations, and synkinaesia) in *isolation* may have been too small to have exerted adequate

rose). One strategy used to explore the neural basis of qualia is to hold the physical stimulus constant, while tracking brain changes that co-vary with changes in the conscious percept (e.g., Sheinberg & Logothetis, 1997; Tong & Engep.8(&)-206si2001.thI-2532

To understand the importance of synaesthesia in illuminating the qualia problem consider the following thought experiment performed on your own brain.

Having established the sensory nature of synaesthesia in our first two subjects, we propose a specific testable hypothesis: That grapheme–colour synaesthesia is

Our scheme invokes limbic structures for explaining the emotional overtones of synaesthesia but it is very different from Cytowic's (1989; 1997) view that it *all*

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