IS SYNAESTHESIA ACTUALLY IDEAESTESIA? AN INQUIRY INTO THE NATURE OF THE PHENOMENON

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Abstract: Synaesthesia is traditionally described as a phenomenon of intermixed senses. This implies that both, the inducer and concurrent operate at the level of their sensory representations. For example, in the case of grapheme-colour synaesthesia, the sensory representation of one type, that of a grapheme, would induce a sensory representation of another type, a colour. This "sensory-sensory" view of synaesthesia has a long tradition as it is embedded also into the very name of the phenomenon: "syn"+"aisthesis" (in Greek: *unity of senses*). However, evidence has accumulated suggesting that we should break out with this tradition and adopt a different view of the phenomenon. In this view, only the concurrent operates at the sensory level of representation. The inducer, in contrast, contributes from the semantic level of representations—a processing stage at which the meaning of the stimulus is extracted and represented. Therefore, synaesthesia can be understood as an unusual type of a "semantic" association whereby, in addition to wiring up different concepts, synaesthesia wires concepts to sensory activations. Thus, a more accurate name of the phenomenon is *ideaesthesia*, coined from "idea"+"aisthesis" (in Greek: *sensing concepts*).

Keywords: synaesthesia, semantics, meaning, concepts, inducer, definition, Glagolitic letters, ideaesthesia,

There is much, objective, third-person evidence that synaesthetic experiences are vivid and realistic (NUNN, *et al.*, 2002; HUBBARD, *et al*. 2005; NIKOLIĆ, *et al*., 2007a). Thus, the "sensory" or "perceptual" nature of concurrents is supported well by experimental investigations. The situation is less clear with the inducers. Traditionally, it has been assumed that inducers operate in synaesthesia at the sensory level too. However, the idea of the sensory nature of inducer's role in synaesthesia is not supported by experimental evidence. A number of experiments suggest that it is the activation of the meaning of a particular stimulus that induces synaesthetic experiences.

For example, one study investigated synaesthetic perceptions when subjects were presented with a physically identical grapheme but, depending on the context, were lead to believe that the grapheme indicated either a digit zero or a letter (e.g. a grapheme can be made to be about equally similar to a number "5" or to an "S"). The results showed that the synaesthetic colors associated with the grapheme changed reliably in dependence on the assumed meaning of the grapheme (DIXON, *et al.*, 2006)[1]. As the stimulus remained constant, the only variable that changed in these studies was the interpretation of the grapheme, i.e. its understood meaning. Therefore, the semantic representation was the factor that determined the associated synaesthetic color. There are also other studies from which similar conclusions can be derived. For example, a stimulus indicating digit "5" can be build from elements that look like digit "2". Depending on whether the attention is focused on the elements or on the whole figure, different concepts are evoked despite the stimulus remaining physically identical (PALMERI, *et al.*, 2002). Here, again, a synaesthete subject perceived changes in the associated color consistent with the

[1] In my lab, we were able to obtain similar results by using a circular grapheme to represent either a zero or letter "O" (unpublished observation).

semantic hypothesis of the nature of the inducer—i.e. depending on the interpretation of the stimulus. There were also other studies whose results suggest semantic nature of inducers (DIXON, *et al*. 2000; RICH, MATTINGLEY, 2003; SIMNER, WARD, 2006), although not always did the authors offer these interpretations.

We recently tested the semantic hypothesis by attempting to induce new associations between the inducers and concurrents. We reasoned that, if the inducer operated at the level of semantic representations, a novel synaesthetic association between a new grapheme could be established quickly, i.e. within minutes, by simply associating an old grapheme with a new one. We taught subjects ancient unfamiliar Glagolitic alphabet. For example, if a synaesthete had a red color associated with Latin letter "A" and learned a Glagolitic grapheme standing for "A", a presentation of the Glagolitic grapheme alone would be sufficient to induce synaesthetic colors previously associated to Latin "A". Thus, synaesthetic colors were transferred as soon as the subjects learned the meaning of the new graphemes. Importantly, this transfer was very fast, requiring <10 minutes of a learning exercise (MROCZKO, *et al*., 2008). We could also prove the existence of the novel association by applying a Stroop task adapted for synaesthesia. This indicated semantic nature of novel grapheme–color associations.

The conclusions about the inducer's semantic nature in synaesthesia were challenged most strongly by the experiments based on serial visual search. One result apparently suggested a different conclusion, i.e. that synaesthetic inducers operate at the level of perception (referred to also as the "sensory" level). The idea was that, if graphemes begin to induce colors at this low level of representation, synaesthetes should be faster in serial search tasks than the control subjects. This experiment required the target and distractor items to be made of different graphemes, each being associated with a different color. A synaesthete subject was found to be much faster in serial search task than a group of non-synaesthete control subjects. This result was taken to support the existence of early, pre-attentive, and perception-related associations between the form of the grapheme and the color. The problem was however, that this study could not be replicated (EDQUIST, *et al*., 2006; SAGIV, *et al*., 2006). In my own laboratory, we also attempted and filed to replicate these result (NIKOLIĆ, *et al*., 2007b). Our synaesthetes were not faster in visual search that the matched controls. Thus, after all, the hypothesis of the low-level association between the inducer and the concurrent has been falsified. Consequently, also the idea that synaesthesia occurs through unification of senses can be considered falsified.

There has been one other relevant study, a derivative from PALMERI, *et al.* (2002), which used not one, but multiple targets in a serial search task, and subjects were instructed to detect the shape formed by the targets rather than detecting a single target (RAMACHANDRAN, HUBBARD, 2001). In this study, synaesthetes performed better than controls, and hence, the results were interpreted as supporting the hypothesis of low-level representation of synaesthesia. However, as mentioned earlier, the perceptual hypothesis has been in the meantime falsified on the basis of the experiments with a single target. Thus, synaesthetes' advantage in tasks with multiple but not in those with single targets can hardly be used as a support for the perceptual nature of inducers. Instead, the reconciliation between the results of RAMACHANDRAN & HUBBARD and those from the serial search experiments has to come from an alternative interpretation of the result of RAMACHANDRAN & HUBBARD. One possibility is that the more complex task, with multiple targets, engages also the semantic networks and that this is the cause of the advantage of synaesthetes. This possibility is suggested by recent studies showing that, with multiple targets, in addition to the detection the targets there is another time-consuming process for learning the locations of these target elements (NIKOLIĆ, SINGER, 2007; MAYER, *et al*., 2007). The later relies on limited-capacity resources of visual working memory and attention, and, most importantly, the effective working memory capacity, and hence the learning efficacy, depend crucially on perceptual conditions (pop-out vs. no pop-out) (NIKOLIĆ, SINGER, 2007). More familiar shapes are expected to be detected faster. Thus, synaesthetic colors may enhance the process of learning the shapes, rather than the detection of the constituent elements, the initial element-detection being executed always slowly but the integration into the shape being facilitated by the synaesthetic colors. In that way, synaesthesia would assist the formation of the perceptual memories of the shapes, which would in turn facilitate later the detection of these shapes in crowded scenes. This hypothesis needs, however, yet to be investigated.

Nevertheless, when put on scales, the evidence for perceptual and semantic hypothesis overweighs convincingly towards the conclusion that the inducers in synaesthesia evoke synaesthetic associations from the higher-semantic levels of representation. There is lack of evidence that inducers operate at the low, perceptual levels of representation. Hence, the events underlying synaesthesia begin unfolding most likely with recognition and classification of each stimulus according to its meaning, the concurrent experiences being induced only in a subsequent stage. In other words, it is the activation of the meaning that causes the perceptual sensations. Thus, the associative semantic networks, which play a pivotal role for non-synaesthetic associations, play a central functional role also in synaesthesia: The usual concept-to-concept associations are extended to the unusual concept-to-percept associations.

These conclusions suggest that we should adjust our understanding of the nature of synaesthesia, which may begin already with the definition of the phenomenon. In light of the presented evidence, it appears incorrect to define synaesthesia as a phenomenon of “intermixed”, “unified”, or “cross-wired” senses. Currently, such definitions of the phenomenon of synaesthesia predominate in the literature, but would obviously have to be replaced by new, more accurate definitions. These would have to involve the terms “semantic”, “meaning” or “concepts”. Here is one proposal: *Synaesthesia is a phenomenon in which a mental activation of a certain concept or idea is associated consistently with a certain perception-like experience.*

Importantly, the issue of the nature of synaesthesia still cannot be considered fully settled. A number of questions remain open. For example, it will be important to extend the studies to forms of synaesthesia other than grapheme-color. Also, the present studies cannot be taken as evidence of non-existence of low-level synaesthesia, i.e. a form that is implied literally by the word *synaesthesia*, and could be also labeled as *synaesthesia literal*. Besides being virtually impossible to prove non-existence of anything, there are other reasons to believe that *synaesthesia literal* may exist in a form that is different from the one studied typically. One possibility is that drug-induced synaesthesia is a true low-level phenomenon. In that case, high-level semantic forms of synaesthesia (e.g. grapheme-color) and temporary, drug-induced synaesthesia may be two different, unrelated phenomena that rely on different mechanisms and are hence, incorrectly labeled the same. If this turns out to be true, it will be no longer justified to refer to one in the context of the other.

Finally, in light of the present conclusions, it becomes obvious that the very name of the phenomenon, *synaesthesia*, is inaccurate and misleading. The question is then, is there a better name for the phenomenon? To be consistent with the tradition, one can ask the following: How would the ancient Greek philosophers name this phenomenon if they also too into consideration the semantic nature of the inducers? One alternative is the word *ideaesthesia*, which is a combination of two ancient Greek words, one for concept, “idea”, and the other for sensation, “aisthesis”. In translation, ideaesthesia means *sensing concepts* or *perceiving meaning*. This sends a considerably different message than does *union of senses*. Thus, given the available empirical evidence, the word ideaesthesia describes the discussed phenomenon much more accurately than the word synaesthesia.

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REFERENCES

DIXON M.J., SMILEK D., CUDAHY C., MERIKLE P.M. (2000), “Five plus two equals yellow”. in *Nature*, Vol. 406, pp. 365.

DIXON M.J., SMILEK D., DUFFY P.L., ZANNA M.P., MERIKLE P.M (2006), “The Role of Meaning in Grapheme-Colour Synaesthesia”, in *Cortex*, Vol. 42, pp. 243-252.

EDQUIST J., RICH A.N., BRINKMAN C., MATTINGLEY J.B. (2006). "Do synaesthetic colours act as unique features in visual search?", in *Cortex*, Vol. 42, pp. 222–231.

HUBBARD E.M., ARMAN A.C., RAMACHANDRAN V.S., BOYNTON G.M (2005), “Individual differences among grapheme-color synesthetes: Brain-behavior correlations”, in *Neuron*, Vol. 45, pp. 975–985.

MAYER J., BITTNER R., LINDEN D., NIKOLIĆ D. (2007), “Attentional demand influences strategies for encoding into visual working memory”, in *Advances in Cognitive Psychology*, Vol. 3, pp. 429-448.

MROCZKO A., METZINGER T., SINGER W., NIKOLIĆ D. (2008), "Immediate transfer of synaesthetic concurrents to novel inducers", in *The 4th Annual General Meeting and Conference of the UK Synaesthesia Association*, Department of Psychology, University of Edinburgh, March 29-30.

NIKOLIĆ D., LICHTI P., SINGER W. (2007a), “Color opponency in synesthetic experiences” in *Psychological Science*, Vol. 18, pp. 481-486.

NIKOLIĆ D., LICHTI P., SINGER W. (2007b), “Synaesthesia does not enable extraordinary speed of visual search”, in UK Synaesthesia Association Meeting, Oxford, March 24-25.

NUNN J.A., GREGORY, L.J., BRAMMER M., WILLIAMS S.C.R, PARSLOW D.M, MORGAN M.J. MORRIS R.G., BULLMORE E.T., BARON-COHEN S., GRAY J.A. (2002), “Functional magnetic resonance imaging of synaesthesia: Activation of V4/V8 by spoken words”, in *Nature Neuroscience*, Vol. 5, pp. 371–5.

PALMERI T.J., BLAKE R., MAROIS R., FLANERY M.A., WHETSELL W. (2002) “The perceptual reality of synesthetic colors”, in *Proceedings of the*

National Academy of Sciences, USA, Vol. 99, pp. 4127–4131.

RAMACHANDRAN V.S., HUBBARD E.M. (2001), "Psychophysical investigations into the neural basis of synaesthesia", in *Proceedings of Royal Society of London Series B-Biological Sciences*, Vol. 268, pp. 979–983.

RICH A.N., MATTINGLEY J.B. (2003), "The effects of stimulus competition and voluntary attention on colour-graphemic synaesthesia", in *NeuroReport*, Vol. 14, pp. 1793–1798.

SAGIV N., ROBERTSON L. (2006) "Does binding of synesthetic color to the evoking grapheme require attention?", in *Cortex*, Vol. 42, pp. 232–242.

SIMNER J., WARD J. (2006), "Synaesthesia: The taste of words on the tip of the tongue", in *Nature*, Vol. 444, pp. 438.