Synaesthesia as an Ideasthesia - cognitive implications

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„I felt like a child that just began learning to write. At first, I didn't see anything else but a strange symbol, black on white. My perception of colours changed only upon learning that the symbol was a Glagolitic letter denoting an 'A'. After I had written it several times and used it as an 'A' in writing words, it eventually ended up intensely coloured in a bright red-brown hue, just like my Latin 'A'!"

This is how synaesthete M. describes her experience in an experiment testing the transfer of synaesthetic colours to novel inducers (Mroczko et al. 2009): In this experiment grapheme-colour synaesthetes like M were presented with letters of an ancient Croatian alphabet, and were asked to write them down and use them in German words instead of their Latin counterparts. As a result, the novel graphemes began eliciting synaesthetic colours. Already within a ten-minute period the Glagolitic graphemes obtained colours exactly like those that have been years-long associated with the Latin counterparts.

This might come as a no-surprise to a grapheme-colour synaesthete. These people build often new synaesthetic connections, e.g. when learning a new language using a foreign alphabet. For synaesthesia researchers, however, a discovery of that fact in an experimental setting was of considerable importance. First, this result demonstrates that novel synaesthetic associations do not necessarily require creation of novel connections between brain areas, as such links cannot be formed within minutes (cf. Jürgens & Nikolić, 2012). Thus, this result poses problems for the traditional theories about the origin of synaesthesia such as the well-known cross-activation theory, stating that synaesthesia stems from unnatural cross-wiring in the brain (Brang, 2011; Ramachandran & Hubbard, 2001a, 2001b).

Second, the correspondence between the synaesthetic colours of Glagolitic letters to those of Latin letters according to the congruency in meaning, and not, e.g., in the shape, hints at the mental mechanism responsible for this transfer: Apparently, information processed at the semantic level needs to be taken into account when understanding synaesthesia (Bargary et al., 2009). The reason that for M., the red-brown colour of Latin letter transferred to its Glagolitic counterpart, is that both graphemes indicated the same abstract concept of the letter ‘A’.

There are also other examples in the research of synaesthesia showing that semantics plays an important role in that phenomenon. For example, Dixon and colleagues showed that an ambiguous symbol ‘Ƽ‘ could elicit two different synaesthetic colours, depending on the context in which it was presented: If it was presented as a member of a set of numbers, it was automatically interpreted as ‘5’, and hence it evoked the colour of that number, which was dark blue for their participant. But if the same symbol was standing instead of an ‘S’ in the word ‘music’, due to the different context, it evoked another colour, namely that of the letter ‘S’ – sunny yellow (Dixon et al., 2006). Thus, in this experiment also the synaesthetic colour was determined by the extracted meaning of the presented symbols.

Julia Simner and Jamie Ward designed another experiment that supported the same conclusion. They presented word-taste synaesthetes with pictures of uncommon objects (Simner & Ward, 2006). In some cases the synaesthetes were not able to recall the name of the presented object but nevertheless, the synaesthetic taste associated with the word was experienced. Thus, for those subjects, to evoke synaesthesia, it was sufficient to know what the object was – i.e. it needed to be classified semantically – while there was no need to activate the word. Therefore, it seems that the synaesthetic experience was associated to the meaning of the object, not to the word.

Another example of a meaning-driven synaesthetic associationss is the recently discovered swimming-style synaesthesia (Nikolić, Jürgens, Rothen, Meier & Mroczko, 2011; see also Mroczko-Warsowicz & Werning, 2012). Experienced swimmers who were also synaesthetes, reported associating a distinct synaesthetic colour to each of the four main swimming styles (crawl, breaststroke, backstroke, and butterfly). Most interestingly, to evoke these experiences, the subjects did not need to be in the pool and swim, and did not even need to imitate the movements of swimming. To evoke synaesthesia it was sufficient to bring up the topic of swimming, irrespective of whether this occurred by words or by pictures. Thus, for these synaesthetes, it was sufficient to think about swimming. Again, it was the pure concept of swimming, and not a particular physical stimulus, that evoked synaesthesia.

The traditional definition of synaesthesia assumes that this is a phenomenon of “merged senses” (Baron-Cohen, 1997, Brang, 2011; Cytowic, 1989; Ramachandran & Hubbard, 2001a, 2001b). However, as we explained, this definition does not fit well with the mentioned results. Obviously, synaesthesia is not a strictly a phenomenon of “associated perceptions” or “united senses”, as the Greek meaning of the term (syn + aisthesis) would imply. Rather, the phenomenon seems to be described better as a set of sensory-like experiences associated to concepts. Consequently, it has been proposed that the phenomenon should be named more accurately "ideaesthesia", which would be Greek for "sensing ideas" (Nikolić, 2009).

This insight about the role of meaning in synaesthesia has important implications for our understanding of the origin of that phenomenon. Multiple researchers came independently to the conclusion that synaesthesia should be explained based on the structure of the same mechanisms that underlie our regular perceptions (Simner et al. 2005; Simner Ward, Huckstep, Tsakanikos, 2006). In agreement with that conclusion we propose that particular emphasis should be given to the aspects of our regular perceptions that involve the interactions between sensory inputs on one side and our conceptual interpretations of these inputs on the other side (Bugelski & Alampay, 1961; Leeper, 1935; Reese & Ford, 1962).

In any form of perception, the conceptual interpretations and expectations mold our sensory experiences, the final percept being a result of the interaction between the two (Bugelski & Alampay, 1961; Leeper, 1935; Reese & Ford, 1962). For example, if we perceive a dog by a visual medium, we instantly activate the relevant knowledge and hence build expectations about the possible inputs through other media, such as the sounds that this animal may be producing (e.g. barking or yelping). Similarly, we would have already predetermined anticipations on how it would feel touching that animal. Thus, our semantic system does not operate only with propositional knowledge (e.g. dogs belong to the biological family canidae), but also with knowledge related directly to our senses, such as the sounds, touches, and even emotions. This knowledge can be activated by an abstract stimulus: It is sufficient to look at a drawing of a dog or merely think about one and our associative memory (Kohonen, 1997) will impact the way we sense the inputs from the world (Mroczko-Warsowicz & Werning, 2012).

Thus, by acquiring an abstract concept ‘dog’ we acquire necessarily also a certain set of “drawers” for the attributes of that dog. These attributes can be called also: the parameters of the concept. Among other information, these parameters contain information about the sensory experiences associated with exemplars of that category. Thus, any experience of a particular dog requires filling up those parameters with the attributes of that particular dog. The instantiation of the attributes constitutes the instantiatiation of the concept

We propose that exactly the same cognitive mechanisms underlie synaesthetic associations. Every inducer, be it a letter, a sound, or a weekday, corresponds to an inner representation, the concept, which necessarily has its assortment of attributes. It is the organization of the attributes of that concept that determines whether someone will or will not have synaesthetic experiences associated to the exemplars of that concept: Synaesthetes are special because some of their concepts posses an additional sensory attribute that non-synaesthetes do not have. This attribute cannot be extracted from the sensory experiences with the concept but is artificially added to the concept. Nevertheless, the attribute can be experienced in a sensory-like manner much like, and nearly as vividly as, any other sensory experiences.

For example, for a number-colour synaesthete the concept ‘number’ possesses an additional attribute ‘colour’ that normally does not exist in everyday sensory experiences with numbers. This special attribute belongs to the concept just as all other non-synaesthetic (i.e., usual) attributes. Hence, this synaesthetic attribute is activated automatically and reliably much like all other attributes whenever the concept of is being activated.

The reason for the fact that some individuals are able to create these additional attributes and others are not is currently unknown, except that this capacity is linked to a genetic predisposition (Asher et al. (2009); Barnett et al. (2008); but see Smilek et al. 2002). Also, for an individual, the ability to endow concepts with additional – synaesthetic – attributes seems to exert a certain degree of generality, as in a synaesthete, multiple forms of synaesthesia tend to co-occur. E.g. a grapheme-colour synaesthete is likely to exhibit also time-unit—space synaesthesia or music-colour synaesthesia. Obviously, once this extraordinary endowment is in place, the synaesthete minds use it for multiple types of concepts.

Importantly, not all concepts are equally likely to associate synaesthetic experiences. Some seem to be much more prone towards synaesthesia, such as, graphemes, time units, and music while others seem to be resistant, such as animals, furniture, or models of cars (cf. Day, 2012). Apparently, more abstract concepts are more likely to associate synaesthetic experiences than the less abstract ones. The fewer normal sensory attributes a certain experience has, the more likely it seems to be given surrogate sensory attributes by synaesthetes.

Let us consider the concept of a 'month'. One may have a vivid perceptual experience of the time span covered by one month when looking at a calendar. But without a calendar at hand, one may have difficulties recalling from the memory contents that would give an impression of the amount of time elapsed within a month. A duration of one month seems not be a sensory-laden experience. The same applies to graphemes or musical notes. They have relatively scarce sensory attributes, often not enough to be specific for the experience of a particular item. As

Rothen et al. (2010) noted, these concepts are cultural constructs that are somewhat distant from direct perceptual experiences

The lack of sensory experiences in concepts may be particularly problematic for a child that begins to learn reading and writing or begins to learn musical notes. While the child may have been interacting until that point in time mostly with sensory-laden objects such as a dog, ball or bicycle, it may suddenly become for the first time challenged with abstract concepts. For synaesthetic children, a help may come through an additional synaesthetic attribute added to the concept, which then enables the child to manipulate the newly learned materials much more easily.

The presently described postulate that synaesthesia is triggered by semantic representations and hence, that it is more accurately described as ideaesthesia, can be used also to derive novel, experimentally testable hypotheses can be derived from. We propose here one:

If synaesthesia reflects a general ability to endow abstract concept types with additional sensory attributes, synaesthetes should have the ability to develop new forms of synaesthesia even in adulthood in a situation in which newly learned concepts are highly abstract and present a learning difficulty for the subject. For example, if a word-taste synaesthetes were in a situation to learn a novel set of abstract traffic signs, the new symbols may become a new class of synaesthetic inducers that associate taste too.

Moreover, if a lack of natural sensory attributes inspires synaesthesia, the development of synaesthetic responses should most likely occur for stimuli that are sensorially most impoverished. In contrast, stimuli rich with attributes should be unlikely to obtain synaesthetic associations. This prediction may be tested in the future using, e.g. a traffic-sign paradigm: As the independent variable, the amount of sensory attributes (the abstractness) of newly learned traffic signs could be manipulated systematically, by adding or subtracting features accordingly. For example, surface colours may be added/removed and shapes may be made more concrete/abstract. These variables should affect the likelihood that new synaesthesias will emerge while subjects are learning to use novel traffic signs.

Clearly, a need exists for further research in this area. Interestingly, recently we witnessed a rising awareness of the limits of the traditional accounts of synaesthesia. Spence (2012) criticises the current trend to include into these accounts seemingly any phenomenon that plausibly might be related to a “merging of the senses” (Baron-Cohen, 1997, Brang, 2011; Cytowic, 1989; Ramachandran & Hubbard, 2001a, 2001b). He suggests identifying an underlying rationale for all kinds of true synaesthesia as opposed to other phenomena that display overt similarities but are genuinely based on different mechanisms (e.g. metaphoric speech). Likewise, Blakemore (2012) stresses the need to separate accurately synaesthesia from “what synaesthesia isn’t”, heading towards building a theoretical link to normal cognition. In the same vein, Simner (2012) calls for definitional criteria for synaesthesia that would be oriented towards a sound theoretical account about its nature. We believe that the notion of ideaesthesia will be tremendously helpful in achieving these goals.

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