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Synaesthesia: Opinions and Perspectives

30 Interviews with Leading Scientists, Artists and Synaesthetes

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Beat Meier:

> I consider the cognitive differences in synaesthetes a consequence of the different knowledge structure that emerges due to synaesthetic experiences, rather than due to the experience *per se*.

Beat Meier, Ph.D., is Associate Professor at the Institute of Psychology at the University of Bern, where he is a research group leader. He studied Psychology, Economics, and Computer Science at the University of Basel, Switzerland, and earned a Ph.D. in Psychology at the University of Bern, Switzerland. He was then a post-doctoral fellow at the University of British Columbia, Canada, before he moved back to Switzerland. His research is focused on understanding the interplay between automatic and controlled processes, in particular in memory, learning and in the pursuit of goal-directed behaviour. Moreover, he is interested in individual differences both on a phenomenological and on a behavioural level. In this context, one line of his work aims at understanding the cognitive basis and consequences of synaesthesia. Overall, he has written more than one hundred scientific publications on the domains of prospective and retrospective memory, implicit and explicit learning, task switching and cognitive control, and synaesthesia. Before his scientific career, he worked as a musician, music teacher, and as a copywriter in an advertising agency. It was at this time that he first came across synaesthesia, due to collaboration with a colleague, a graphic designer, who had excellent visual memory.

How do you define synaesthesia? Is it one phenomenon or several?

The term synaesthesia is used as an umbrella term to refer to a "mixing of the senses" in various contexts and thus it comes in various guises. In literature, for example, synaesthesia can refer to metaphorical language (for example, "a sharp cheese", to "see red", etc.). Synaesthesia can also refer to cross-modal correspondences such as associating small objects with high pitch and light colour, and large objects with low pitch or dark colours. It can also refer to transient altered states of consciousness in which visual and auditory hallucinations co-occur; for example, after the intake of psychedelic drugs such as LSD or mescal.

Most relevant, however, synaesthesia also refers to an individual difference property, a variation of experience that affects a small proportion of people. It involves the automatic activation of an unusual concurrent sensation in response to an inducing stimulus; for example, a colour experience in response to a letter printed in black. It emerges early in development, has a genetic basis, and manifests in various guises. I typically refer to this definition of congenital synaesthesia when I use the term synaesthesia.

It comes in different forms or types which often co-occur. Most typical are inducers such as digits, letters, words, days of the week, months, or sound, and the concurrent experience is most typically related to colour or space. However, many more combinations are possible. The particular associations (i.e., inducer-concurrent pairs such as grapheme-colour) are typically idiosyncratic at the individual level and stable across time. In fact, the consistency of the synaesthetic associations is typically used as a defining characteristic of synaesthesia.

To what extent is synaesthesia inborn (genetically determined)? What are the causal influences of learning and cognition in its occurrence?

Congenital synaesthesia is most likely genetically determined. It runs in families and there are several studies that suggest a genetic basis. Interestingly, synaesthesia is rather associated with absolute pitch

than with austism, although there have been studies that found higher prevalence of synaesthetes among people with a diagnosis of autism spectrum disorder.

Besides a genetic disposition, however, there seem to be several critical phases for synaesthesia to occur and remain. As many synaesthetic inducers are cultural artefacts such as letters or digits, it is likely that a first critical phase occurs around the age of 7 years when children learn these artefacts. There seems to be a second critical phase during adolescence, during which some teenagers seem to lose the experiences. The inducer-concurrent pairs remain stable across adulthood; however, the strength of the experience can decline in older age.

In what ways is synaesthesia an advantageous, an impeding, or a neutral condition?

Most evidence for a cognitive advantage comes from the domain of memory; in particular, for grapheme-colour synaesthesia. However, not all stimuli which trigger synaesthesia are better remembered, and some stimuli which do not trigger synaesthesia are better remembered. Although, on average, synaesthetes, in particular those with coloured graphemes, have a slight memory advantage; but the memory of synaesthetes is not as extraordinary as has been suggested by a few single case studies (such as S., who was documented by Luria).

Another domain for which synaesthesia seems to be favourable is the domain of creative professions. There is evidence that synaesthetes are more often engaged in creative activities; however, standardized tests do not show consistent advantages.

Are people with synaesthesia special in any other way? Do all people have synaesthesia to some extent?

Multiple and strong synaesthesias can affect concentration and affective reactions. However, in general, I consider synaesthesia as an interindividual variation that comes together with many other interindividual differences such humour, intelligence, etc.; and although there seems to be a synaesthetic profile for some personality traits and cognitive styles, these variations are in an ordinary range.

I don't think that all people "have" synaesthesia. If we consider synaesthesia as a genetic condition, then it does not seem likely that all people have synaesthesia in the sense of idiosyncratic, involuntary and consistent experiences. However, it is possible to induce synaesthesia-like experiences, for example with drugs such as LSD, even in people who are not congenital synaesthetes.

What is your story (and impression) of reading Alexander Luria's *The Mind of a Mnemonist*?

It is a very impressive case study. I consider Shereshevsky an extraordinary person with extreme vivid imagery. It is important to take into account that he made a living as a professional mnemonist and he strategically combined his synaesthetic experiences with mnemotechniques such as the method of loci and imagery. His veridical memory ability is very impressive but his extraordinary memory is not only due to his synaesthesia. I found it frightening that, in the end, he seemed to have lost semantics by exaggerating memory techniques for veridical verbatim recall.

Why is it important to do research into synaesthesia? What are its promises for cognitive science or science at large?

First, I personally find it important that psychologist can describe and explain human experiences in general. As a memory researcher, I am particularly interested in the amount and extent synaesthesia can help to boost memory. Last but not least, synaesthesia research may be informative regarding issues related to consciousness and plasticity more generally.

Which type of synaesthesia fascinates and/or intrigues you the most? What is the most memorable (interesting, baffling) case of synaesthesia that you came across during your career as a synaesthesia researcher? Why was it interesting and how would this contribute to (neuro)science if we could know its mechanisms?

At the moment, I have a strong interest in understanding the relationship between absolute pitch and synaesthesia; however, my research in this phenomenon has just begun (Meier & Glasser, 2019).

In retrospect, I find the phenomenon of swimming-style colour synaesthesia particularly interesting because it may serve as a model for how synaesthesia can generalize across different inducers and how expertise (or habitual exposure) interacts with the formation of synaesthetic associations (Nikolić et al., 2011). The two cases whom we have investigated were both professional athletes for a long time (i.e., including the period when they acquired the synaesthetic swimming-style colour associations), and they had extensive training and thus opportunity for "practicing" the specific associations. This may be similar in the development of other forms of synaesthesia, which also likely involve a tremendous number of exposures until the associations are stable and occur involuntarily.

What is your current "pet peeve" or the most annoying misconception about synaesthesia? What ideas about synaesthesia has your experience of researching synaesthesia made you get rid of? What do you feel is the main thing currently being overlooked or ignored in synaesthesia research?

Maybe a "pet peeve" is the claim that synaesthetes have extraordinary memory. Research clearly shows that, in general, people with grapheme-colour synaesthesia have an advantage in some tests with some types of materials, but this advantage is not "extraordinary". Research on other types of synaesthesia is still in its infancy and it does not seem to be the case that all forms of synaesthesia lead to the same memory advantages (Lunke & Meier, 2019; Meier & Rothen, 2013).

Another issue that I believe needs more attention is the cognitive representation of synaesthetic inducers and concurrents in the knowledge system. Synaesthesia is a conscious phenomenon as an inducer triggers a concurrent conscious experience. Importantly, even without the presence of the inducer, a synaesthete knows that a particular inducer triggers that experience. Therefore, the association between the inducer and the concurrent is represented in the knowledge system. This has the consequence that it is not only the world of experience of a synaesthete that is much richer, it is also the knowledge organization that is different compared to non-synaesthetes. It is very

likely that these differences in the knowledge system rather than the experiences per se cause the cognitive advantages that can be observed in cognitive domains such as memory or creativity (Meier, 2013; Lunke & Meier, 2019).

An important insight is that there are huge individual differences among synaesthetes. It seems that the cognitive profile of different forms of synaesthesia also varies substantially and thus it is important to take into account different forms to come up with more general conclusions (Lunke & Meier, 2018; 2019; Meier et al., 2013). The number of inducers that triggers synaesthetic experiences in a particular person and in a particular type of synaesthesia should be taken into account. Notably, some types of synaesthesia have only very few inducers (e.g., swimming-style colour synaesthesia) while other forms have many more (Meier et al., 2014, 2015).

How do you explain the neurological (neurophysiological) mechanisms of synaesthesia if pressed for a bootstrap answer? What scientific model of congenital synaesthesia based on hard data do you subscribe to?

There is convergent evidence that, on a neuroanatomical level, there are difference between brains of synaesthetes and those of non-synaesthetes, in particular with respect to increased connectivity. However, it is difficult to say whether these are cause or consequence of synaesthesia. We know that the plasticity of the brain is huge and that changes in connectivity can also occur even across rather short environmental stimulation periods. Thus, we need more data, in particular related to the development of synaesthesia, to inform the differences that are observed on a neural level.

The results of your study show several neurocognitive differences related to synaesthesia — in different types of memory, visual imagery and different aspects of visual perception manifesting as cognitive styles or tendencies. How do you now disentangle the causal interactions of synaesthesia-related cognitive traits with regards to individual differences in attention, sensitivity, perception, memory and

synaesthesia? Which ones have similar neuronal roots, which are the cause and which the effect of having synaesthesia?

As noted above, I consider the cognitive differences a consequence of the different knowledge structure that emerges due to synaesthetic experiences, rather than due to the experience per se. In contrast, differences on a perceptual level may be directly related to the synaesthetic perceptions. For example, one can consider synaesthetes that have colour as a concurrent as colour experts and this expertise may be directly related to differences in the perceptual system.

Can synaesthesia be learned or acquired through exposure to specifically designed experience such as training?

As synaesthesia involves a genetic component, it follows that those who do not have the genetic predisposition cannot acquire synaesthesia. However, it is possible to learn associations and thus it is also possible to mimic synesthetic phenomena. For example, synaesthetic Stroop effects are possible to mimic even after a rather short grapheme-colour-association training (Meier & Rothen, 2009). More extended trainings have revealed that non-synaesthete participants can be trained such that they report colour experiences at the end of the training. However, and this is one of the critical differences to congenital synaesthesia, these experiences disappeared again quickly after the training. Thus, training may be interesting in terms of investigating plasticity or to evaluate the specificity of certain methods, but may not be very informative with respect to understanding congenital synaesthesia.

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