Are we all some kind of synaesthete?

Review of Aleksandra Maria Rogowska's "Synaesthesia and Individual Differences"

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Synaesthesia is often described as a fascinating and 'unusual' condition because of the quality and variety of the additional experiences that those with the condition report (try to imagine being able to smell particular sounds, or describe the colour of a person's name). Academic researchers worldwide have attempted to uncover the mysteries of what synaesthesia actually is and why it develops in some people but not others. The quirkiness that sometimes characterises synaesthesia was possibly once a hindrance to its establishment as a legitimate topic of scientific enquiry during much of the 20th century. However, following a resurgence of scientific interest in the field during the 1980's and 1990's, synaesthesia slowly established itself as an up and coming (and scientifically legitimate) field of study. Even though the author of the book being discussed here does not necessarily share the view that synaesthesia is 'unusual' in a neuropsychological sense, readers will undoubtedly find much to think about from this well-researched piece of work.

Book and Author

In her book "Synaesthesia and Individual Differences" Aleksandra Maria Rogowska delivers a wealth of information in five short but scientifically rich chapters. One of her goals is to convince us that synaesthesia, a condition characterised by additional experiences (e.g. the colour red) that are triggered by certain kinds of stimuli (e.g. letters), may not be so unusual after all. Throughout the book, Rogowska conveys her message in a matter of fact style that most academics will be accustomed to. It is no surprise then that Rogowska is an assistant professor at the Opole University of Technology, Poland with wide research interests in synaesthesia, sport, art, and education.

Rogowska is clearly an effective scientific writer, the format that defines the layout of the book is detectable and consistent from the outset. Each chapter introduces a new set of individual

differences (e.g. attention, memory, personality, intelligence etc.) and explores how each one might relate to linguistic-colour synaesthesia. Here, linguistic-colour synaesthesia refers to automatic experiences of colour when presented with written and/or spoken linguistic stimuli such as numbers, letters, names, months etc. In the examples given in the book, participants' synaesthetic experiences were elicited by presenting both spoken and written stimuli at the same time (see below for more details concerning synaesthesia tests). Although synaesthetic experiences can be elicited from either written or spoken stimuli, Simner, Glover, and Mowat (2006) suggested that synaesthetic processing may rely more on graphemes rather than phonemes. This suggestion came from their finding that participants were slower at reporting their synaesthetic colours for spoken versus written stimuli. This time delay could possibly have resulted from the generation of graphemic units (e.g. letters) from the phonemic (i.e. spoken) representation.

To bring the reader up to speed, Rogowska provides a brief literature review at the beginning of each chapter and then guides us into her own piece of original research. This simple format kindly offsets the otherwise dense scientific material packed into each chapter making it easier for the reader to avoid getting lost in a sea of information. Aside from the original research, it is obvious that Rogowska has some genuinely interesting (and at times controversial) things to say about synaesthesia, these small offerings (which are discussed below) are a pleasant respite from the formal scientific tone that non-academics may find somewhat less inviting. There are several recurring themes in the book, one of which is the idea that we all exist on a kind of synaesthetic spectrum similar to other individual traits such as personality or intelligence. Another recurring point of discussion concerns Rogowska's own theories about the development of synaesthesia, which she says may occur as a kind of cognitive support mechanism as a result of developmental deficits (more on these themes later).

The book is exhaustive in the amount of material that it covers, with Rogowska's own original research taking up a large proportion of the overall content. Because the structure of this book is heavily research-led, it is tempting to provide an equally formal and scientific review of each of the findings Rogowska presents. Providing such a review however would not be sufficient since Rogowska herself, in true academic style, offers her own critiques and honest criticisms for the reader to digest themselves. Therefore, this review will focus to some extent on the research

element of the book but also on providing a commentary on some of Rogowska's own claims about synaesthesia itself.

Synaesthesia as a continuous variable

From the outset, it is clear that Rogowska feels it is time to tweak our approach to the study of synaesthesia, and what better place to start than with her own research. Traditional methods within synaesthesia research usually rely on administering a consistency test for a particular type of synaesthesia, individuals positively identified as 'synaesthetes' are then compared (using whatever measure the experimenter is interested in) to a group of 'non-synaesthetes'. Consistency tests would traditionally take place over two separate testing sessions so that their data from the first session could be compared with that of a later session (typically after an interval of at least one month). The use of online consistency tests however have made it possible to accurately and reliably detect synaesthesia in a single testing session (Carmichael et al., 2015). The Synesthesia Battery (Eagleman et al., 2007) is one such online test for different types of synaesthesia that has become very popular in research settings. During the consistency test for coloured letters and numbers, the Synesthesia Battery will present participants with the 26 letters of the English alphabet and numbers ranging from one to nine (see figure 1). For the example given here, each stimulus would be shown to the participant a total of three times resulting in 108 stimulus presentations. During each separate stimulus presentation participants are shown an on-screen colour picker and they are asked to choose which colour best represents their synaesthetic association. A consistency measure is calculated based on the differences between the participants colour selection for each individual stimulus. Consistency of synaesthetic associations is regarded as the primary hallmark that characterises the condition. A synaesthetic individual who experiences the word 'Monday' as dark grey will always experience the same colour for that particular word.

Having said the above, it is currently debated as to whether learning or memory might play a role in synaesthetic consistency. Previous studies have found that non-synaesthetes can behave remarkably similar to genuine synaesthetes following repeated training sessions in which non-synaesthetes learn certain letter-colour associations (Meir & Rothen, 2009). Crucially however, Meir & Rothen found that when the non-synaesthetes were presented with the letters (i.e. the ones that they had

previously learned to associate with colours) the actual experience of colour was not elicited. Rather, the non-synaesthetes reported that the letters triggered a memory of the learned associations. From this, Rogowska suggests that the only way for studies to maximize their confidence in identifying true synaesthetes is by using a combination of qualitative and quantitative data, with synaesthetes being identified only if they report both the experience and an appropriate level of consistency.

One of Rogowska's main arguments is that our current method of identifying and then comparing synaesthetes to non-synaesthetes may not actually represent the true nature of synaesthesia. She proposes that synaesthesia, instead of existing as a dichotomous condition that some people have and other people do not, may instead represent more of a trait that exists within the general population. Viewing synaesthesia as a continuous trait is intriguing for a number of reasons. Firstly, this approach has practical implications in terms of affording more freedom during statistical analyses, in this way it would be possible to investigate all sorts of effects using regression or mediation techniques to see how synaesthesia relates to other variables. Secondly it says a lot about Rogowska's own theoretical views about the nature of synaesthesia itself. Put plainly, Rogowska suggests that we all might be some kind of synaesthete existing along a continuous spectrum, with weaker and stronger forms of synaesthetic associations. This is an intriguing suggestion, however the difficulty then arises when trying to decide how to categorize individuals as having associations that are strong enough to classify them as being a true synaesthete. Rogowska suggests that even though synaesthetes and non-synaesthetes may actually be more similar than dissimilar, the question still remains as to whether or not there is case to distinguish ordinary association with unusually strong synaesthesia and where along the synaesthetic spectrum we decide to place that boundary.
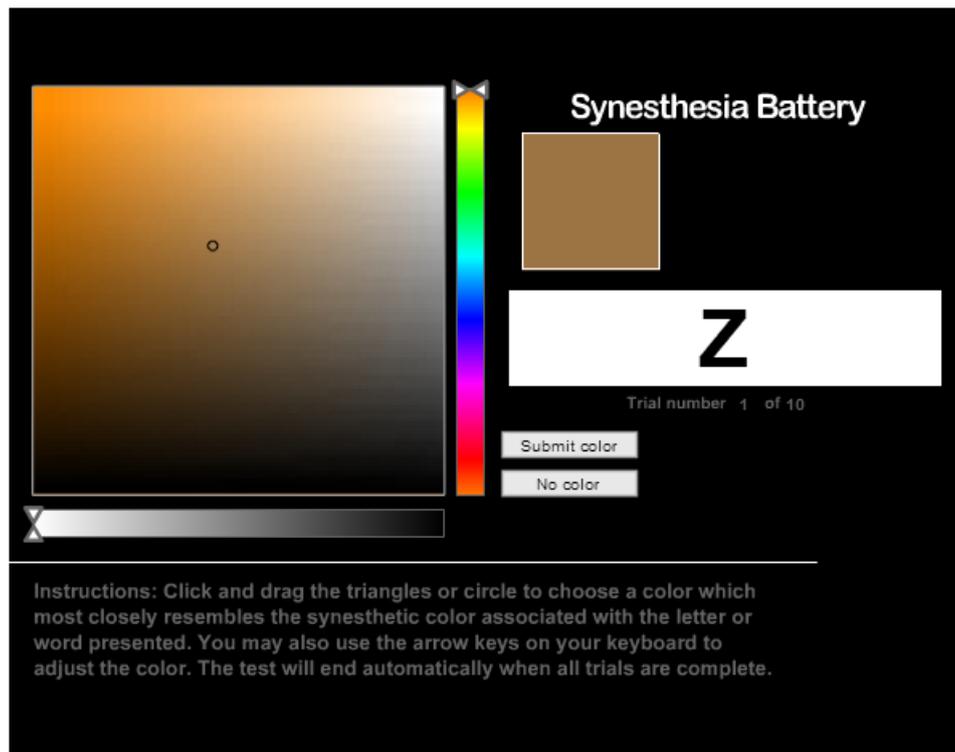
Figure 1 screenshot of a trial for the Synesthesia Battery (Eagleman et al., 2007). During the consistency test for grapheme-colour synaesthesia participants are required to move a curser to select the colour that they perceive for each number/letter, each individual stimulus is presented three times in order to calculate consistency of synaesthetic associations.

The Linguistic-Colour Association Test (L-CAT)

Rogowska makes her attempt to bind theory to practice by introducing us to her own method of quantifying synaesthesia on a continuous scale. Rogowska's Linguistic-Colour Association Test (L-CAT) provides a measure of synaesthesia based firstly on more traditional test-retest consistency methods and secondly based on the range of synaesthetic associations. This second approach provides an additional indictor of the strength of an individual's synaesthesia based on the number of word-colour associations within several linguistic categories (e.g. days, months, letters etc.). The utilisation of this approach lies in the fact that it allows Rogowska to take full control of her data and perform various kinds of statistical analyses (e.g. regression analysis) that may otherwise have been difficult to achieve. Out of the 161 participants that took the L-CAT, her analyses revealed very

similar profiles between synaesthetes and non-synaesthetes (as they would traditionally be classified) in terms of the existence of concrete common linguistic-colour associations. Concrete word-colour associations are those that are considered more typical or conventional, for instance lemons are usually associated with the colour yellow, while the letter 'b' is often associated with the colour blue. Rogowska suggests that it is very difficult to discriminate between synaesthetes and non synaesthetes based on these concrete associations and that they are often derived from learning processes and enculturation. Furthermore, Rogowska states that synaesthesia may be based on these concrete associations much more than previously thought and that synaesthetic-like associations are a more common occurrence within the population as a whole.

Rogowska suggests that "synaesthesia is not an anomalous phenomenon but an extremely strong involuntary and abstract form of association". She sets the stage for her own original research by proposing that the vast amount of synaesthetic associations in existence could be determined by an infinite number of factors. From this, the reader is guided from Rogowska's own views about the nature of synaesthesia (i.e. by its continuous nature) to how this might be utilised for legitimate scientific enquiry. Rogowska's aim is to explore how a variety of individual differences such as intelligence, memory, emotion, personality etc. might be related to either the presence or strength of linguistic-colour associations.

The compensatory hypothesis

Another recurring element in the book concerns what has been termed the compensatory hypothesis (Rogowska, 2011). Rogowska introduces us to the idea that linguistic-colour synaesthesia might occur as a result of some sort of developmental deficiency that occurs early in life. More specifically, she suggests that linguistic-colour synaesthesia may develop when a cognitive problem exceeds the developmental capability of a child during the stages of language acquisition. This is interesting as it suggests that the purpose of synaesthesia may be to aid the cognitive system in better understanding abstract concepts, with the synaesthetic concurrent (e.g. colour) forming an automatic attribute of a variety of concepts learnt during childhood. One piece of evidence that Rogowska cites in favour of this hypothesis is the fact that a sample of linguistic-colour synaesthetes, that she tested for one of the studies described in the book, were more likely to have vision defects

(e.g short or long sightedness). Rogowska suggests that these vision defects may disrupt written language processing, resulting in compensatory processes that provide the individual with an additional mentally represented attribute (i.e. linguistic-colour synaesthesia) that may help to improve linguistic skills.

The compensatory hypothesis further echoes one of Rogowska's earlier statements about the development of synaesthesia, her assertion that "synaesthesia cannot emerge from birth" highlights the fact that the condition must have at least some sort of developmental trajectory. Rogowska clearly subscribes heavily to the idea that learning plays a vital role in the development of synaesthetic associations. This is not a new idea and is frequently debated in the synaesthesia literature with some studies suggesting a congenital basis for synaesthesia and some suggesting that associations may be formed during childhood (see Cohen Kadosh, Henrik, and Walsh, 2009). Having said this, the familial nature of synaesthesia is known as it has been shown to run in families (Barnett et al., 2008). In addition, evidence suggests that certain genes involved in cortical development (e.g. during pruning) may also be involved in synaesthesia development (Carmichael and Simner, 2013). It is more conservative to suggest then that the development of synaesthesia may rely on the interaction between genotype and phenotype, which also includes the interplay between our cognitive systems and learning environments.

Original research

This review would not be complete without at least some mention of Rogowska's actual research. Given Rogowska's novel approach, one could not help but get excited about what kind of interesting new findings she has to share with us. Somewhat disappointingly then, the reader is quickly informed that the results should be considered more of a preliminary step towards new directions in the field of synaesthesia and Rogowska warns us on multiple occasions that her findings should be taken more as inspiration for further enquiry. Nevertheless, here we can see how her attempt to reclassify synaesthesia actually works out in practice by correlating the strength of synaesthetic associations with other variables of interest.

Chapter 4 explores some of the cognitive determinants of linguistic-colour synaesthesia such as memory, imagination, and attention. Rogowska demonstrates that some of the variables under investigation do show significant relationships to the strength of linguistic-colour synaesthesia. For instance, synaesthesia is found to significantly correlate with absorption, a trait that is closely connected to visual imagery and related to other aspects such as fantasy-proneness and hypnotisability. While this does sound like an interesting finding, the reader (especially those without advanced knowledge of statistics) would highly benefit from more clarity in the reporting of the results, since it can at times become confusing when trying to interpret several analytical techniques involving the use of multiple different scales. This is especially apparent when interpreting the results of some of the reverse-scored scales, for instance Rogowska explains that synaesthetes scored significantly higher in absorption compared to non-synaesthetes but also that stronger linguistic-colour synaesthesia was related to lower absorption. Although knowledge of statistical techniques and procedures is not necessarily a prerequisite for understanding the content of the book, a basic familiarity will certainly be beneficial. Aside from this caveat, it is clear that Rogowska's approach can certainly be effective in practice and has the potential to teach us new and interesting things about the nature of synaesthesia.

Rogowska also explores the relationship between synaesthesia and personality, utilising the more traditional group comparisons method as well as the additional use of correlations. Using the Big Five model (John et al., 1991) which measures personality based on five factors (Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness), Rogowska demonstrates that her sample of synaesthetes score significantly higher in conscientiousness compared to non-synaesthetes. Correlations also revealed that stronger synaesthetes tended to be significantly more introverted and less agreeable. At this late stage in the book we come across a rare omission in Rogowska's otherwise thorough and exhaustive review of the literature. Rogowska suggests that no other systematic investigations of synaesthesia and personality have been conducted in the last 30 years. Banissy et al. (2013) however conducted a very similar investigation to Rogowska's study (it is likely that her omission was due to both works being published at similar times). Banissy et al. (2013) also followed the Big Five model, and somewhat similar to Rogowska they found that synaesthetes were significantly lower in agreeableness compared to non-synaesthetes. In contrast to Rogowskas study however Banissy et al. also found that synaesthetes tended to be significantly higher in

openness (Rogowska found no effects for openness in her study). Furthermore, the significantly higher conscientiousness scores for the synaesthetes in Rogowskas study were not replicated in the study by Banissy et al. (2013). Overall, it seems that low agreeableness tends to be a common factor observed in synaesthetes, while more research will need to be conducted in order to clarify the nature of conscientiousness and openness in synaesthesia.

Rogowska's original research is effectively executed and she successfully utilises the advantage of quantifying synaesthesia on a continuous scale, as well as performing more traditional analyses based on group comparisons. There are many novel and interesting investigations presented in the book, however Rogowska herself refers to some of her findings as weak and underpowered. This is perhaps a little self-critical, as many psychological investigations (including those in synaesthesia research) are performed under similar constraints. Rogowska's work will undoubtedly be useful for inspiring future investigations, whether they choose to adopt her approach or more traditional methods.

Concluding thoughts

The purpose of this commentary aimed to provide a discussion of some of the more intriguing aspects of Rogowska's arguments including her alternative approach to the study of synaesthesia along with her own theories regarding its development based on cognitive deficits occurring early in life. The majority of this book essentially introduces us to Rogowska's original research, and while the dense scientific material and explanation of statistical procedures does not necessarily encourage long reading sessions it is hard to ignore both the quantity and quality of Rogowska's work. The reader is presented with some genuinely interesting and effectively executed research and although there are limitations (e.g. low sample sizes) it is clear that Rogowska has achieved her goal of showing that our investigations of synaesthesia do not have to rely on one type of research method alone. Overall, Rogowska provides a comprehensive examination of linguistic-colour synaesthesia and how it relates to several different aspects of the self. There is enough material presented here for at least one of the five chapters to grab the interest of any individual who may already have an interest in the field.

Even though the tone of the book may feel somewhat lacking in narrative flair, this is redeemed by the truly stimulating content of some of Rogowska's arguments about the nature and development of synaesthesia. Her 'Compensatory Hypothesis' is certainly an intriguing idea and is sure to provoke discussion amongst academics who may (or may not) share Rogowska's opinions. Rogowska, in her own words, does not take the 'safe' path in her investigation of linguistic-colour synaesthesia and instead takes us on an alternative journey where all of us to some extent might be considered some kind of synaesthete. Her finding that synaesthetes and non synaesthetes are not easily distinguishable and actually share many similarities (i.e. in terms of concrete associations) may be a step in the right direction to supporting her argument. Having said this it is likely that not everyone will agree with her proposal and more work will need to be done to explore the link between common association, synaesthesia, and the role of learning processes and enculturation.

Rogowska suggests that we use her work as a stepping stone, a point of reference from which an eager researcher might derive some inspiration to conduct his or her own research using more robust methods and larger sample sizes. While Rogowska's findings are not about to revolutionise our conception of synaesthesia, those with at least some academic background will appreciate Rogowska's effectively-executed body of original research and attempts to provide her own take on what synaesthesia actually is.

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