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Varieties of grapheme-colour synaesthesia: A new theory of phenomenological and behavioural differences

Jamie Ward *, Ryan Li, Shireen Salih, Noam Sagiv

Department of Psychology, University College London, Gower Street, London WCIE 6BT, UK

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Abstract

Recent research has suggested that not all grapheme-colour synaesthetes are alike. One suggestion is that they can be divided, phenomenologically, in terms of whether the colours are experienced in external or internal space (projector–associator distinction). Another suggestion is that they can be divided according to whether it is the perceptual or conceptual attributes of a stimulus that is critical (higher–lower distinction). This study compares the behavioural performance of 7 projector and 7 associator synaesthetes. We demonstrate that this distinction does not map on to behavioural traits expected from the higher–lower distinction. We replicate previous research showing that projectors are faster at naming their synaesthetic colours than veridical colours, and that associators show the reverse profile. Synaesthetes who project colours into external space but not on to the surface of the grapheme behave like associators on this task. In a second task, graphemes presented briefly in the periphery are more likely to elicit reports of colour in projectors than associators, but the colours only tend to be accurate when the grapheme itself is also accurately identified. We propose an alternative model of individual differences in grapheme-colour synaesthesia that emphasises the role of different spatial reference frames in synaesthetic perception. In doing so, we attempt to bring the synaesthesia literature closer to current models of non-synaesthetic perception, attention and binding.

Keywords: Synaesthesia/synesthesia; Space perception; Binding; Attention; Colour/color; Grapheme

1. Introduction

In recent years, the main focus of synaesthesia research has shifted away from demonstrations that the reported phenomena are genuine (although this clearly remains crucial) towards integrating various empirical findings within an explanatory framework. One difficulty in putting forward a coherent explanatory framework for synaesthesia is that there are a number of findings in the literature that appear to be mutually inconsistent with each other. For example, some studies suggest that synaesthesia can be induced pre-attentively (e.g. Smilek, Dixon, Cudahy, & Merikle, 2001) whereas other studies do not (e.g. Mattingley, Rich, & Bradshaw, 2001). At

* Corresponding author. Fax: +44 20 7436 4276.
E-mail address: jamie.ward@ucl.ac.uk (J. Ward).

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present, the source of these inconsistencies is unclear. However, a likely candidate for explaining the inconsistencies is in terms of qualitative individual differences between synaesthetes that, otherwise, have the same pairing of inducers (e.g. graphemes) and concurrent experiences (e.g. colour). The aim of the present study is to examine these individual differences further in order to develop a new explanatory framework of one particular type of synaesthesia; namely, grapheme-colour synaesthesia.

At present, there are two main accounts of individual differences in grapheme-colour synaesthesia. One account, termed the projector–associator distinction, is motivated by different phenomenological reports of synaesthetes (Dixon, Smilek, & Merikle, 2004; Smilek & Dixon, 2002). Some synaesthetes report that when viewing visual graphemes their synaesthetic colours exist in external space and are superimposed on the text. These have been termed projector synaesthetes. Others report experiencing colours, when viewing graphemes, that appear in their ''mind's eye'' or an internalised space. These have been termed associator synaesthetes. It is to be noted that not all phenomenological reports map exactly on to this dichotomy. For example, some synaesthetes experience colours in external space but the colours ''float'' at some fixed distance from their body rather than exist ''out there on the page''. It remains an open issue as to how these synaesthetes should be characterised. An alternative account has been termed the higher–lower distinction, and is motivated by differences in the level of representation of the inducing stimulus (Ramachandran & Hubbard, 2001b). In the terminology of Grossenbacher and Lovelace (2001) all types of synaesthesia have two essential elements: a stimulus that triggers the synaesthesia (an inducer) and the synaesthetic experience itself (the concurrent). Whereas the projector–associator distinction refers to differences in the concurrent, the higher–lower distinction refers to differences in the inducer. In particular, higher synaesthesia is assumed to reflect a conceptual level of induction (e.g. the meaning of a digit) whereas lower synaesthesia is assumed to reflect perceptual processing (e.g., of the digit's form). Taking the validity of these distinctions at face value (for now) and assuming them to be orthogonal, this generates four different varieties of grapheme-colour synaesthesia. However, an alternative proposal is that these two distinctions are the same; such that all projector synaesthetes are lower synaesthetes and all associator synaesthetes are higher synaesthetes (Dixon & Smilek, 2005; Dixon et al., 2004). This study will empirically assess this suggestion, along with several others. Before doing so, it is important to consider the evidence put forward so far for these distinctions.

1.1. The projector–associator distinction

Dixon et al. (2004) reported an objective measure that reliably discriminated between the 5 projector and 7 associator grapheme-colour synaesthetes that they tested. Their task was a variation on the synaesthetic version of the Stroop paradigm that has now been used in many other studies (e.g. Mattingley et al., 2001; Mills, Boteler, & Oliver, 1999). In the standard form of these tasks, the synaesthete must name the actual colour in which a digit or letter is presented and ignore their synaesthetic colour. The synaesthetic colour can either be congruent with the actual colour (e.g. a red ''A'' where their synaesthetic colour for ''A'' is red) or incongruent with it (e.g. a green ''A'' where their synaesthetic colour for ''A'' is red). Synaesthetes are slower in the incongruent relative to congruent condition implying that their synaesthetic colour is automatically elicited even when irrelevant to the task. Dixon et al. (2004) compared the standard version of the task with one in which the stimuli are the same but in which the instructions are reversed such that synaesthetes are required to name their synaesthetic colour and ignore the real colour. Projector synaesthetes were faster at naming synaesthetic colours relative to real colours, but associator synaesthetes were faster at naming real colours relative to synaesthetic ones (a double dissociation). Their explanation of this is that projected colours are more automatic because they reflect reciprocal activation between regions involved in grapheme recognition and colour processing early in the visual stream, whereas associator synaesthetes have links with more conceptual aspects of colour and vision that arise later. They do, however, also discuss a number of alternative explanations. For example, the reason why associator synaesthetes may be slower at naming their synaesthetic colour could be because their synaesthetic colour is, by definition, in a different spatial location to the attended grapheme. Naming their synaesthetic colour would require a shift in attention from the grapheme location to the colour location. The reason why projector synaesthetes are faster at naming their synaesthetic colour relative to actual colours (the reverse dissociation) is harder to account for but may reflect that fact that their synaesthetic colour occludes or is more vivid than the actual colour.