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How do synesthetes experience the world?

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1. Introduction

Synesthesia corresponds to a condition in which “stimulation in one sensory or cognitive stream leads to associated experiences in a second, unstimulated stream” (Hubbard, 2007, p. 193). It has also been characterized as a “startling sensory blending” (Cytowic, 1997, p. 17) “not experienced by most people under comparable conditions” (Grossenbacher & Lovelace, 2001, p. 36). The first medical account came from George Sachs (1812), an albino and synesthete, who describes at the end of his medical dissertation how black letters appear to him in various shades (quoted by Ward, 2008). Previous mentions, more or less akin to thought experiments, are found in Locke (1690) and Leibniz (1765) who report of a blind man for whom thinking of the color scarlet is like hearing “the sound of a trumpet”. Later, Fechner (1871; followed by Galton, 1880) published more general surveys of colored letters, also known as “photisms”. Since these early studies, the initial source of puzzlement has remained the same. What is particularly distinctive of synesthetes is their ability to give consistent pairings of apparently unrelated sensory attributes, like letters and colors, over a very long stretch of time (Baron-Cohen et al., 1993; Rich et al., 2005²). This ability seems to go beyond what normal memory can achieve and suggests that the associations are not random. This is what leads to accept the existence of a specific experiential basis for these associations.

What sort of experience do synesthetes have when they report black letters being red, green or yellow? How can we explain some persons seeing colors when they hear sounds or musical notes? Synesthesia raises both broad questions about the exact nature of conscious experience as well as more technical challenges to philosophical models of perception and mental processes. Take the example of D. (mentioned in Ortmann, 1933) for whom B2 is green; that is, she has an experience of green whenever she hears B2. The problem here is not merely that D's experience is different from that of others' but that it is at odds with reality: The green she experiences is not a sign that the note out there is really green. What can this experience be about then? Does it attribute an illusory color property to the sound? Does it have any representational content at all? Synesthetic experiences, as

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²This is known as the “test of genuineness”. The same participants' inducer-concurrent pairings are tested and re-tested after a long period of time. For example, in Baron-Cohen et al.'s (1993) study, synesthetes gave 92% of consistent replies when given an unexpected retest after one year, compared to 38% of consistency for control participants retested with warning after one week (see Deroy & Auvray, forthcoming, for a discussion on the validity of this test).

we start to see, do not easily fit in the dominant representationalist framework (Alter, 2006; Gray, 2001-a; Wager, 1999, 2001). The same is true for functionalism: like other perceivers, D. also sees green when she looks at leaves and grass. What is puzzling is that her green experience sometimes seems to result from auditory stimulation and, other times, from visual stimulation. Supposing that experiencing green constitutes a single kind of mental state (a kind of phenomenal, conscious state), this leads to admit that the same kind of state arises from two distinct streams and occupies two irreconcilable roles in D's cognitive system, which appears to contradict the functionalist principles (Gray et al., 1997, 2002, see also Macpherson, 2007, for a discussion). Finally, synesthetic cases like D's also challenge models of mental architecture, that is the modular, impenetrable character of perception (Baron-Cohen et al., 1993; Gray, 2001-b; Segal, 1997) and the neat individuation of the senses (Keeley, forthcoming). If visual experiences of color can result from auditory stimulation, the senses might not be as separated – or easy to individuate – as usually posited.

Synesthesia has thus been taken as a serious source of objections to standard theories of perception and mental processes. Most, if not all, of these philosophical objections have been advanced on the basis of three main general assumptions, noticeably that synesthesia is: (1) a single, more or less unified, condition; whereby (2) some individuals have an additional experience, adjoined to normal perceptual experience; and that (3) this teaches us something about non-synesthetic perception.

The aim of this chapter is to offer a critical look at these three assumptions, which, as we shall see, appear more and more fragile once we consider the variety of cases and their more comprehensive studies. This has important consequences regarding the reality and scope of the philosophical challenges posed by synesthesia, to which we return in conclusion.

1. Characterizing synesthesia: a unified kind or a variety of phenomena?

1.1. Cataloging the cases

Synesthesia has long been seen as a natural kind, but it comes in range of sub-species. Since Sachs (1812) and Fechner (1871), synesthesia has been primarily studied through the induction of atypical color experiences by speech – be it read, heard or both. But other forms of synesthesia do not involve colors or linguistic items: digits or months of the year can elicit certain locations in space (Galton, 1880; Sagiv et al., 2006), words can induce taste sensations in the mouth and tastes can trigger tactile shape sensations: for instance, the word 'jail' tastes of cold, hard bacon, for J. (Ward & Simner, 2003) and chicken is pointy for M. (Cytowic, 1993). Other rare cases lead to proprioceptive experiences, which involve movement and bodily postures (Devereux, 1966, quoted in Cytowic, 1989). In cases of ordinal linguistic personification, numbers or days of the week are associated with personality traits, emotions or gender (e.g., Smilek et al., 2007-a). In addition, most often, synesthetic experiences come with an emotional dimension, besides the sensory one (see Hochel et al., 2008, for a discussion).

There is variation among individuals not only in the kinds of stimuli that elicit synesthetic experience (often labeled “the inducer”, see Grossenbacher & Lovelace, 2001), but also in the kind of experience that is elicited (the “concurrent” or “synesthetic” experience). For instance, people do not report the same colors for all letters and numbers: J can be blue for some and orange for others. There are, however, some general trends (e.g., see Rich et al., 2005). These recurrent patterns across individuals reveal for instance that A is most often

red across multiple color-graphemes synesthetes (Day, 2005; Simner et al., 2005) and vowels tend to elicit more luminous and intense colors than consonants (Smilek et al., 2007-b; Spence & Deroy, forthcoming-a and Deroy & Spence, submitted, for a discussion). Still, these trends do not exhaust the richness of individual experiences: the overall vividness and intensity of synesthetic experience varies from one person to the other. Some investigators wonder whether some of these variants do not deserve to be recognized as distinct kinds on their own. For the various cases labeled as synesthetic might, in fact, be underlain by very distinct processes, some of which have little or nothing to do with sensory perception (see Simner, 2007, 2011, and Marks, 2011, for a review of recent debates).

Large-scale studies (e.g., Day et al., 2005; Simner et al., 2006) reveal that grapheme-color and word-color cases are in a significant majority. Why? The question is not disconnected from the previous one, as the frequency might be due to the fact that synesthesia is a too encompassing category, where further sub-species have to be recognized. Several other divisions have been introduced, that could help explain away the dominance of linguistic-color synesthesia and cut down the category into more finely individuated types.

1.2. Individuating the various types of synesthesia

Ramachandran and Hubbard's (2001-a) distinction between "lower" and "higher" synesthetes for instance might prove useful to break synesthesia into finer categories. Lower synesthetes are sensitive to the basic sensory features of the inducer (e.g., contrast, lines and orientation of the letter on the page) whereas higher synesthetes are sensitive to the kind of object they recognize (A's and B's for instance)³. Dixon et al. (2004) have also proposed a sub-categorization of synesthetes into "associators", who are the majority and experience the atypical color in an internal space (in the "mind's eye", as they report) and the rare "projectors" for whom the atypical color appears to be "out there", for instance overlaying the letter on the page. Resorting to such categorization matters, as projectors have often provided the core of philosophical challenges due to their perceptual-like spatial experiences (e.g., Macpherson, 2007; Wager, 1999).

These divisions may not, however, be sharp (see Simner, 2011), as synesthetes fall on a continuum on both the high-low scale and the associator-projector one. In addition, the frontier between "higher" versus "lower" synesthetes is quite permeable, as it is unclear how independent higher synesthetic experiences are from variation in the more basic features of the tokened type. Subtle color changes in synesthetic experiences arise for instance when small changes in font are introduced: although 'R' and 'r' are tokens of the same type and might both appear orange, the hue of orange one of them elicits may be brighter or more saturated than the other. Moreover, the transfer of synesthetic experiences from one type of alphabet to another – which, at first sight, can be taken for a sign that higher synesthesia is at stake – is shown to also depend on phonemic and visual similarities between the letters (Witthoft & Winawer, 2006). Finally, Hubbard et al. (2005) and Brang et al. (2011) have cast further doubt on the isolation of higher synesthesia, by showing that the visual form of letters may have an impact on their coloring: letters that are closer in shape (e.g., KVWXY) may be closer in color than those that differ in shape (e.g., CUDOQ). Similar questions arise for the projectors versus associators divide. Ward et al. (2007, 2010) showed, for instance, that the degree of projection varies with the task. In addition, Edquist et al.'s (2006) study revealed that some synesthetes are left out by this

³Note that this is orthogonal to the problem of knowing whether synesthesia is stimulus-driven or internally-driven. Even for lower synesthetes, the basic sensory features might have to be recognized before they trigger the synesthetic experience.

categorization, as some grapheme-color synesthetes are neither associators, nor projectors. For them, the colors are extended but not in any particular location, that is, neither in the mind's eye, nor out there. More importantly, there might not be such clear empirical cases of perfect projectors consistently having synesthetic experiences of color patches with a determined extension and localization (Hupe et al., 2011).

To summarize, understanding synesthesia supposes that one has a clear sense of what its various types are. But research still struggles to encompass individual variations. Finding the right sub-categories constitutes a pressing challenge, as researchers feel that their object is always one step ahead, challenging the bases on which they approached it, and is “so large and agile” that it eludes them (Marks, 2011, p. 48).

1.3. Is synesthesia a case of “atypical perception”?

The most pressing issue is to define the nature of these atypical experiences. A frequent interpretation is that synesthetic experiences are all instances of *perception*: synesthesia is said to occur when “stimulation of one sensory modality automatically triggers a *perception* in a second modality, in the absence of any direct stimulation to this second modality” (Harrison et Baron-Cohen, 1997, p. 3, italics are our emphasis). This definition is widely quoted and often endorsed in the literature (e.g., Baron-Cohen et al., 2007; Macpherson, 2007). Elsewhere, synesthesia also gets defined as “the stimulation of one sensory modality reliably caus(ing) a *perception* in one or more different senses” (Cytowic, 1995) or as an “anomalous sensory *perception*” (Asher et al., 2009).

Yet, one might immediately object that synesthesia cannot really count as perceptual because it is not veridical (Gray, 2001-a) or caused by the presence of the appropriate stimulus (Sagiv et al., 2011). Lycan (2006) and Fish (2010) both recommend, for instance, synesthetic experiences to be treated as cases of hallucination, whereas Simner (2007) insists that it is a higher cognitive-linguistic phenomenon. The characterization of synesthesia as being perceptual certainly depends first on how one captures the synesthetic experience, and second on how one defines perception, noticeably regarding its correlation with the external world. These are the issues which will be addressed in the two subsequent sections.

2. What is it like to have a synesthetic experience?

2.1. Are synesthetic and non-synesthetic experiences subjectively distinguishable?

A first question to ask is whether synesthetic experiences are subjectively indistinguishable from perceptual experiences. Note that from a philosophical point of view, the indistinguishability is not sufficient to claim that synesthetic experiences should count as perceptual (as noticeably pressed by disjunctivist accounts, see Logue, this volume). However, there is a widespread agreement, coming from the argument of hallucination, that if an experience is subjectively distinguishable from a perceptual one, by being for instance not vivid or devoid of phenomenal presence, it is enough to declare that it is not perceptual (see Crane, 2011, for a discussion).

The reports from synesthetes do not deliver a straightforward answer: synesthetes often say that they are aware of a difference between their synesthetic and non-synesthetic experiences while these two also seem to them comparable. The documented reports and various observations converge to stress that a synesthetic experience can be as vivid and forceful as other experiences induced by other kinds of stimuli, and that it can also

spontaneously lead to beliefs – for instance, the belief that B2 is genuinely green (Cytowic, 1993). Such synesthetic experiences seem comparable to perceptual experiences. In addition, synesthetic experiences are also atypical, i.e., not shared by the majority of the population. This atypicality can explain why a synesthete distinguishes between his idiosyncratic synesthetic experience and beliefs, which nobody shares, and the other set of experiences which lead to commonly accepted beliefs.

However, being rare and not being shared are not good reasons to consider a certain kind of experience as being non-genuinely perceptual. Take for instance what happens in taste perception: very few persons are super-tasters and perceive or believe that Brussels sprouts are unbearably bitter. The rare character of the former experience doesn't rule out that super-tasters perceive certain tastes. Likewise, the idiosyncratic difference exhibited by synesthetic experiences is not sufficient to say that they are not perceptual.

The atypical character of synesthetic experiences must be handled with care, especially because rarity is sometimes taken to be a definitional feature of the condition (e.g., Grossenbacher & Lovelace, 2001). Indeed, synesthetic experiences do not seem to be so frequent, but this does not help determining their nature. The unusual character rather comes from having, to put it in general terms, a certain “extra” by comparison with the class of experiences which is otherwise normally triggered by the same stimuli in the same conditions. Synesthetic experiences then are atypical in the sense that they are anomalous. They differ from what we otherwise suppose to be the rules of normal perception. The important remaining difficulty that we address in the subsequent section is to capture these very peculiar experiences.

2.2. A frequent confusion about the inducer-concurrent pairings

Understanding the “extra” which constitutes the synesthetic experience proves highly problematic. Reports from synesthetes stress how difficult it is to communicate on private experiences, especially when they are unusual. As one of them describes: “I have trouble putting into words some of the things I experience. It is like explaining red to a blind person or middle-C to a deaf person” (Cytowic, 1989). Thus, when D. reports having the experience of a “pretty yellow green” when she hears a B2 and of a “dirty yellow-green” when hearing a D# (Ortmann, 1933), we can wonder what she means here by the term “green”? Does it mean the same thing as when D. reports that a certain leaf looks green? The worry here is not merely linguistic: it matters whether or not her synesthetic sensations of green are *identical* to her non-synesthetic ones, for which she uses the same descriptor.

It is generally agreed that terms used to report synesthetic experiences can be taken at face value and used to think about the “extra” as being more or less similar to the kind of experience otherwise described by the terms. Synesthetic reports are then usually analyzed into two lists of separate components: one corresponds to this extra experience, on which the synesthete is asked to report, and the other corresponds to the inducer, which can be manipulated externally. In a very general way, experimental researches consist in varying the inducer and measuring the modifications on the side of the concurrent. What is misleading then is certainly not this method of squaring reports within such inducer-concurrent pairs, but the kind of interpretation it encourages. There is, as we want to point out, a method-content confusion, going from the testing of synesthesia through associated pairs to the idea that synesthetic experiences themselves are a pair of experiences.

The notion of an atypical synesthetic concurrent often transfers to the idea that synesthetic experience is a conjunction of two distinct experiences: the concurrent would be enjoyed

by synesthetes only whereas the inducer would be common to synesthetes and non-synesthetes alike. An illustration of this transfer can be found in Macpherson (2007) when she recommends changing Cytowic's description of synesthesia as a "startling sensory blendings whose quality seems difficult for most of us to imagine" (Cytowic 1997, p.17) to the claim that synesthetes have an "additional experience" joined to the otherwise normal experience common to us all. Synesthesia, she admits, corresponds to cases where "an experience or element of experience is *associated with* some sensory modality and is *distinct from*" the former (trigger) experience (Macpherson, 2007, p. 70). Keeley (forthcoming) also notes that "in synesthesia, it is not the case that the neurotypical sensations are replaced or eclipsed by the synesthetic ones; instead they are experienced in a *conjoint* fashion" (see also Wager, 1999).

A synesthetic experience where, for instance, a green concurrent is induced by a sound is understood as leading to the typical experience of the sound, plus the unusual experience of green. This view constitutes what we call a "dualistic model" of synesthesia. This model is largely assumed both in the scientific and philosophical literature. Yet, we argue, it is a disputable and possibly distorting way of capturing the atypical experiences documented in the empirical literature, as there are good reasons to theorize about these experiences in a non-dualistic way.

2.3. Synesthetic experiences and phenomenal enrichment

Most of the reports do not imply that synesthetes have an extra experience. They are perfectly compatible with the more minimal and cautious idea that synesthetic experiences come with a richer sensing, that is, some extra-sensational aspect. Dualistic models infer too quickly that this richer sensing means that synesthetes enjoy another experience with a distinct content and character, which can be unproblematically defined and detached from the other contents and characters of the overall experience. Therefore, a crucial point behind these dualistic models is that synesthetic experience divide into two otherwise normal experiences, or at least that a shared normal perception will appear once the extra-experience is left out of the picture. This possibility, we argue, is at odds with the evidence.

The first point comes from the internal dependence of the synesthetic extra on the content of another experience. We contend that the concurrent is never experienced in the way the fuller experience which seems to be reported would be. It is noticeably never experienced by itself, but always as grafted onto the content of another experience. We should not be misled here by descriptions that make them analogous to classical experiences – for instance of color stains or sounds. Take the report that the letter E is loud: how can one have a sensation of loudness in the absence of other perceived properties such as pitch and timbre, which are not attributed to E? Synesthetic colour is often just an addition of hue to a grapheme. But there is no non-synesthetic experience of hue without spatial location, or without variations in saturation, lightness, etc., that is, in the absence of precise localization and other spatial and qualitative properties. In synesthetic experience, the extra is all in the phenomenal character, and akin to the enrichment of the existing character: it falls short of being the possible content of a *distinct, normal* experience.

A second argument against dualism comes from the strong connection that exists, within experience, between the synesthetic extra and the content of perception relative to the inducer. The available evidence actually goes against the independence claim. On the contrary, it inclines to treating the concurrent as interacting, or rather interfering, with the inducer, and this at rather early stages of the perceptual process. This is true for instance for perceived localization, as measured through what is called "pop-out" effects: when

asked to localize a target object (for instance, the black digit 2) among several distracting objects (for instance black digits 5), some of the synesthetes who experience red 2's perform faster than non-synesthetes. The red color of the 2's allows them to easily distinguish the 2's from the 5's, whereas the typical experience of non-synesthetes constrains them to a longer serial search (Ramachandran & Hubbard, 2001-b)⁴. Here the extra facilitates the localization of black digits (as would do adding colors to the graphemes for a non-synesthete).

Interferences with the identification of perceived objects have also been demonstrated by some variants of the Stroop task (Stroop, 1935). The original task revealed that people take longer to name the color of a written word if the ink does not match the word than if the two match. For example, it takes longer to name the color green when it is printed on the word "red" than when it is printed on the word "green". A similar effect is observed when grapheme-color synesthetes are asked to name the actual color of a grapheme while ignoring the synesthetic color it elicits. If the letter R is synesthetically experienced as orange, synesthetes will be slower in naming the ink's color when the letter is printed in blue than when it is orange (e.g. Mills et al., 1999)⁵. These results underscore what we have already suggested: the concurrent and the experienced inducer are rather two aspects of the same *experience*, intricately connected and difficult to disentangle when asked to attend selectively to one of them.

Insisting that the concurrent is not distinct from and merely conjoined to the content of an otherwise perceptual experience provides a good reason to stand back from the dominant dualistic models. At the same time, more needs to be done to account for the atypical insertion of this synesthetic extra which closely interacts with the other experienced contents. Drawing on Evans' (1982) distinction between the richness (i.e., the number of distinct dimensions) and the fineness of grain (i.e., the number of distinct perceptible positions on each dimension), we contend that the concurrent only exists as an extra-dimension, that is an *enrichment* of other contents. This preserves the idea of a supplement, while not granting any real or theoretical independence to the concurrent as a separate or detachable experience. Another, closely related way to conceptualize its relation to the perceptual experience of the inducer is to think about the experience hosting a form of parasitic phenomenal character.

Recognizing that synesthesia consists in the occurrence of atypical, enriched experiences finally leaves us with an appropriate answer to the subjective indiscriminability question: the concurrent does not need to be granted with a perceptual status on its own, but it inherits the same subjective perceptual reality as the overall experience which it comes to enrich.

4 It should be mentioned that several studies (e.g., Palmeri et al., 2002; Sagiv et al., 2006-b; Smilek et al., 2001) showed that this synesthetic pop-out effect needs to be further qualified. Although fast, it does not happen instantaneously, suggesting that synesthesia occurs early in perceptual processing, but not prior to attention.

⁵These results, like in the classical task, remain ambivalent as to whether the interference occurs at the perceptual level (e.g., the letter E is automatically perceived by the synesthete to be red, and this perceived redness interferes with the "true" color which is also perceived) or at the semantic level (the synesthetic experience of red makes one automatically tag the concept red, and this concept slows down one's ability to access the concept of the "true" color). Note that we are not saying that these results are sufficient to demonstrate a perceptual interference but that, in combination with other results, they provide cumulative evidence for the interference occurring, at least partly, at the level of perceptual experience.

3. Synesthetic experiences and perception

Are synesthetically enriched experiences *fully* perceptual? The question continues to make sense if one considers that the issue is not settled only at the phenomenological level that was described in the former section. Besides having a certain phenomenal character, perception is usually granted with three other key features: it co-varies with changes in the physical environment, it represents an object and finally, it recruits certain specific organs and brain areas.

Addressing the perceptual status of synesthesia requires one to verify how synesthetic cases fit with these requirements. Before handling this problem, it is important to underline that each is the topic of vibrant disputes. For instance, some take the presence of phenomenal character to be a contingent feature of perception (see Prinz, this volume), as perception extends to unconscious cases. The requirement that perception causally co-varies with external features might have to be relaxed to accommodate the perception of high-level properties or of interoception. The idea that perception is representational is widely accepted by representationalist and intentionalist accounts, but enactivists and direct realists will relax or give it up (see Jacob, this volume, for an elaboration of this point). Finally, accepting that perception maps onto specific brain areas is in line with most contemporary physicalist sympathies, but it can be relaxed or given up by functionalist and non-physicalist accounts (for different reasons such as multiple realizability in the first case and metaphysical dualism in the second). The goal of the last part of this chapter is not to argue about which criteria should be included or prevail in the definition of perception, but to assess the perceptual status of synesthesia in light of each of these requirements.

3.1. The co-variation criterion

What determines the occurrence and the nature of synesthetic experiences? Addressing this question is fundamental if one requires perceptual states to be environment-driven and not mind-driven. A perceptual state, such as hearing a sound, is indeed *caused* by physical stimulation and its content *co-varies* with changes in the environment. Certain cases of synesthesia resemble such states by being triggered by physical stimuli and varying with their properties. For instance D., the synesthete described in Ortmann's (1933) detailed single-case study, has synesthetic experiences that vary with properties of the auditory stimuli. Difficulties come from less straightforward cases for which the nature of the correlated experience appears to be mind-dependent. These cases occur mainly either when there is independence of the synesthetic experiences from certain variations in the external stimulus or when there are synesthetic experiences in the absence of an external stimulus. These two cases need to be considered independently.

As was said earlier, the dominant type of synesthesia consists of colors elicited by graphemes. Such synesthetes can be sensitive to the tokening of a certain type of letter or word, while being relatively indifferent to more minute changes in their physical instantiation (see 1.2). These so-called higher synesthetes respond in approximately similar ways to a wide range of physical stimuli as long as they fall in the appropriate kind. For instance some of them have the same synesthetic experience with auditory or visual instantiations of the letter R and, in the latter case, for letters printed in different fonts. Recent evidence additionally reveals that such synesthetic experience can rapidly transfer to new fonts, that is, to previously non-experienced sets of physical features presented or identified as members of a previous kind of letter (Mroczko et al., 2009).

It is worth stressing that, from a philosophical point of view, the existence of such pure higher synesthetes, if any, does not necessarily lead to the rejection of the perceptual nature of synesthesia. The fact that a state responds to high-level, and not merely physical, properties does not necessarily mean that it cannot be perceptual. Some have argued (see Bayne, 2009; Siegel, 2006) that being an A, like being a tiger, a pine-tree or an R can be part of the perceptual content. This, in turn, needs to be separated from the question of whether this kind of property needs to be conceptually recognized (as accepted for instance in Simner, 2007, but see Deroy, forthcoming, for a discussion).

More serious worries come from cases where a conceptual or an emotional mental state suffices to trigger a synesthetic experience. Dixon et al. (2000) report the case of C, a digit-color synesthete who has a colored experience of numbers not only when viewing the external stimuli but also when conceptually entertaining them. In their experiment, C was presented with mathematical additions, such as '5+2', followed by a colored patch which was either congruent or incongruent with the color that C associates with the result of that sequence (i.e., 7). In this variant of the Stroop task, C had to name the color of the patch before reporting the arithmetic solution. The results revealed slower responses for incongruent colors than for congruent ones (for instance when the patch is yellow and seven is associated to that color in C's synesthetic repertoire). What matters here is that the immediate cause of the synesthetic experience cannot be the physical sensory stimulation, (i.e., the digit resulting from the addition), as the number 7 was never presented.

This kind of experiment confirms the possibility for automatic synesthetic experiences to be both mind-driven (here by a mental calculation) and object-driven (whether physically present low-level features or higher-order types such as a numeral). However, it should be mentioned that cases of purely mind-driven synesthetic experiences, that is, cases which would *only* be triggered by mental representation of an object – and not by its physical presentation – are yet to be found. In the meantime, internally-driven cases seem to exist only as an interesting extension – but extension nonetheless – of the externally-driven ones.

It is therefore premature to say whether internal determinants such as concepts are in themselves sufficient to elicit synesthetic experiences (see Spiller & Jansaria, 2008, for more data) and what role they play alongside necessary physical stimuli, in explaining some variations and occurrences of synesthetic experiences. It is fair to say that for a vast majority of cases, including for higher synesthesia, the presence of external physical stimuli and an independent object remains a necessary condition, and that its properties explain the variations and distribution of the synesthetic experiences obtained.

3.2. The representational criterion

It is possible to go beyond covariation to saying that perceptual states *represent* a mind-independent object (or property). Again, we will pass on many of the discussions surrounding the formulation of this definitional requirement and examine synesthesia only in the context of the idea that perceptual states have a certain representational (or intentional) content in virtue of their phenomenal character. For instance, the perceptual state of experiencing blue represents the property of being blue. To maintain this relation, it is necessary that the phenomenal character *supervenes* on the representational content; in other terms, that the phenomenal character is determined by what is experienced. As Tye puts it, “necessarily, experiences that are alike in their representational contents are alike in their phenomenal character” (Tye, 2002, p. 137).

At first sight, synesthetic cases seem contradict this form of representationalism. This is illustrated by Wager's (1999) case of Cynthia, a colored-hearing projector synesthete who experiences a determinate shade of red at a precise location when she hears middle-C. What Cynthia's synesthetic experience represents is arguably middle-C. In the absence of any phenomenal enrichment, middle-C is also the only thing that is represented by the normal auditory experience of Norma. There is therefore a difference in phenomenal character without any difference in intentional content (see also Rosenberg, 2004, for a similar objection). Note that Cynthia is more of an ideal case, given that, as was mentioned, pure projectors might not exist. There is therefore a worry that such a case, and its further variations (Wager, 1999, 2001; Gray, 2001-a) brings the debate away from empirically valid objections, and joins thought-experiment challenges to representationalism, such as the inverted spectrum case (Block, 1978). That being said, let's pursue the argument.

As was underscored by Lycan (2006) and by Wager (1999) himself, the objection is directed against externalist representationalist theories, like Dretske's (1995, 2000) or Tye's (2000) which require that the intentional object (represented in perception) is identical to the physical object. An internalist account has no problem in saying that Cynthia's experience represents both middle-C and redness, although this implicitly lead him to endorse the (otherwise misleading) dualist view: in that case, as Lycan (2006) puts it, "vision is telling her that there is redness dead ahead, just as in the cases of after-images and hallucinated rodents". What the internalist account needs to explain then is what makes one aspect of the experience true and the other one false, given that the two are subjectively indistinguishable (contrarily to after-images). Our account in terms of enriched experiences might make this task less easy than the dual one, for their unique content will have to have the same veridicality conditions.

From an externalist perspective, though, the objection does not seem fatal. As pressed by Alter (2006), an externalist does not need to claim that *every* phenomenal difference introduces a difference in representational content. Both a tactile sensation and a visual sensation can represent an external object, although the two *feel* different (see Tye, 2000, for a defense of this view on behalf of representationalism). The same kind of phenomenal character can go in various guises, and representationalists who accept this claim can interpret Cynthia's synesthetic experiences as being just a declination within the general kind of "experiencing middle-C". Her experience will then represent middle-C and so does a non-synesthetic experience, as much as the look of a cube and the tactile feel of a cube can represent the property of being cubic.

This line of reply turns out to be problematic though in the synesthetic case, at least in the sense that it conflicts with another frequent representationalist credo: the transparent character of experience. The transparency claim goes further than the basic representationalist supervenience claim. The latter merely posits that states which have similar kinds of intentional content are alike in kinds of phenomenal characters; whereas transparency means that the phenomenal character is *identical* to the intentional content. Obviously then, if the phenomenal character is richer in the synesthetic experience of middle-C, the intentional content of that experience must certainly be richer as well. But in which sense does an experience of red middle-C represent *more* of the external object than the non-synesthetic experience of middle-C? No further attribute of the object seems captured in the synesthetic experience. The fact that the same attributes can be represented faster does not introduce a difference in content, despite the suggestion offered by Sollberger (forthcoming) to rescue representationalism from synesthesia's challenge.

The challenge synesthesia raises for representationalism certainly goes beyond this rapid overview. It seems fair to conclude that the challenge is serious and that synesthesia is difficult to square with the representationalist's requirements for perception. Each solution raises problems: first, if one claims that synesthetic experiences represent a non-existent intentional object – or misrepresent the existing one – then synesthetic experiences end up amounting to hallucinations or illusions. This is at odds with the idea that they behave like perceptual experiences and follow systematic co-variations with the external environment (as described in 3.1), as the empirical evidence yet supports. If synesthesia is an illusion, it is a very specific one, for which we need a better definition. Alternatively, the representationalist can choose to accommodate synesthetic experiences within the range of possible variations in the way a certain object is represented in perception. But the stretch might be difficult: very different phenomenal characters have to represent the same external object; up to the extent that a synesthetic experience of an orange sound represents the properties of a sound as does a strictly auditory experience. The final option opened to the representationalist is to show that the enriched synesthetic experiences have a richer representational content than the non-synesthetic ones. This is an interesting, but difficult route to explore if synesthesia were to count as perceptual.

3.3. The sensory processing criterion

Turning to neurological criteria, synesthesia's perceptual status raises further concerns. Certain physicalist accounts are happy to think that kinds of mental states also correspond to kinds of neurological states. Perceptual states, in that sense, can be defined as those resulting from the activation of specific brain areas (sensory ones). How easy is it to apply this criterion to synesthetic states? As this field of research is fast moving, we will only offer a succinct review of the key data, while focusing on their consequences for physicalist requirements.

Brain imaging studies have revealed that synesthetic experiences correlate with some co-activation of sensory brain areas. When synesthetes hear one of the sounds that trigger colors for them, there is an increased activity in the area in the fusiform gyrus known as V4 or V8, that is, the brain areas involved when non-synesthetes perceive colors. Interestingly, such increased activation does not occur in non-synesthetes trained to associate sounds with colors and who are subsequently asked to visually imagine the corresponding color when hearing the sound (Nunn et al., 2002). Other – non strictly sensory – areas of the brain also show specific patterns of activation in some synesthetes (i.e., parietal and frontal regions, see Rouw & Scholte, 2007). Synesthesia is likely to be defined in more general terms as an increased cortical connectivity between various sensory brain regions, either directly or indirectly (via the mediation of non-sensory processing). Whether indirect activation and top-down influences mean that synesthesia cannot count as sensory is controversial (see Simner, 2007, for a discussion). Further questions then arise as to whether the increased connectivity comes from a lack of inhibition or from an abnormal increase in connectivity (see Bargary & Mitchell, 2008, for a review). In any case, the localization of the activity turns out to be less crucial than finer structural or functional differences.

More recently, doubts have also arisen as to whether shared localization in V4/V8 means that the same kinds of neurons are active in synesthetic color-enriched auditory experience and non-synesthetic color experiences. A study by Van Leuwen (2010) revealed that the neurons involved in synesthetic experiences do not show the same patterns of suppression through repetition as the ones involved in typical perception, concluding that “the neural

correlates of synesthetic color experience and real color experience are not fully shared” (Van Leuwen, 2010; see also Hong & Blake, 2008, for further discussion). This questions how thinly or broadly the kinds of physical processes have to be individuated; in other words, is shared localization sufficient, and which additional aspects have to be included?

Further neuroscientific investigation of synesthesia is certainly needed, and speculation is here useless. It is yet worth noting that resorting to a neurological or physicalist definition to defend the fact that synesthesia is a form of perception might turn out to lead to a Pyrrhic victory, finally challenging the way one thought about the nature and individuation of sensory areas in the first place. This leads us to the final conclusive remarks.

4. Conclusions and further challenges

Every paper on synesthesia must end up on a cautious note, given the obvious need for further exploration. Substantial steps can yet be made, and are worth debating, on the basis of revised assumptions. We have shown in the first part of the chapter that the unity of the condition should not be taken for granted, and that many cases fall under the word “synesthesia” for reasons that need to be clarified. This variety might be a legitimate concern for a neurological definition of synesthesia (Simner, 2011). Yet there is still room, or so we argue, to think about synesthesia not just as *ad-hoc* set of cases as long as one focuses on two things: thinking about the proper individuation of the various types of synesthesia and looking for a overall definition of synesthesia in terms of the kind of mental states (and in this case characteristic kind of experiences) it gives rise to. The second part of the chapter is our attempt to provide such a definition. Although more needs to be done, it seems important to move away from a method-content confusion and from dual models of synesthetic experiences. Synesthetic experiences can be defined as richer, unified experiences, where an additional sensory attribute (or qualia) gets hosted in the content of perception. How does this bear on the third assumption, that synesthesia teaches us something more general about the mind, and more specifically about perception? No simple answer can be provided, but several things need to be distinguished.

On the one hand, the rejection of the dual model is particularly important, as it pushes away the idea that synesthesia challenges functionalism. As Gray has put it on multiple occasions (Gray et al., 1997, 2002, 2006) synesthesia might seem to refute the claim that experiences with different functional properties necessarily have different qualitative properties – a claim which holds at least for strong versions of functionalism, (see Macpherson, 2007; see also Block, 1980 and Shoemaker, 1975, for more general discussions).

The objection only works under the view that a colored-hearing synesthete is in the same kind of conscious mental state (e.g., experiencing red) when she sees a cherry and when she hears a certain sound. This understanding is ruled out once synesthesia is interpreted, as we suggest it should be, in a non-dualistic way. Gray’s premise that synesthetic and non-synesthetic experiences (say of the color red) have a shared content rests on the dual experience model we have rejected. Once synesthetic experiences are understood as phenomenally enriched experiences, there is no such thing as a single kind of content (red) that could be detached and compared across synesthetic and non-synesthetic experiences. The background premise is blocked and the challenge therefore does not hold⁶.

6 Our goal here is not to defend functionalism, be it its strong or weak versions, but to stress that synesthesia does not constitute an empirical objection to this model.

If synesthesia does not in itself provide good reasons to give up functionalism, why is it so challenging? A main challenge, as we have seen in part 3, is to see whether enriched synesthetic experiences deserve to be classified as perceptual. As was stressed, several conditions need to be considered besides the fact that they enjoy the same conscious status as perceptual experiences before they can be granted with a full perceptual status. These conditions involve the extent to which these experiences co-vary with the external environment, the kind of representational content they come to have and their neurophysiological correlates. Given the data currently available, it is certainly difficult to confirm that all these requirements are met, or that they are met by all types actually considered as being synesthetic.

For the sake of the argument, let us postulate that some cases of synesthesia fulfill all these conditions. Granting that there are cases of synesthetic perception, what do they teach us about typical, i.e. non-synesthetic, perception? Two attitudes can be adopted here: one granting that synesthesia is continuous or analogous to non-synesthetic perception and the other, that it remains an idiopathic, isolated condition. This dilemma is what we expect to be synesthesia's core challenges. Saying that synesthetes and non-synesthetes are on a continuum leads to the problem of theorizing the “more or less” synesthetic aspect of all perception, whereas saying that it is perceptual but distinct from typical perception will oblige to think about perception as coming in very distinct *kinds*. These two very distinct routes leave us to explore perception as a more varied or more disunified phenomenon than what was, and often still is, assumed.

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