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Introduction

When Tomasz Komendzinski first approached us, about three years ago, with the prospect of being guest editors for a special issue of *Theoria et Historia Scientiarum*, focusing on synesthesia, we were highly excited and felt quite honored by the invitation, but also found ourselves somewhat suddenly at a loss as to just how to proceed. In conversation with Komendzinski about the proposed issue, Day mentioned to him that many if not most current articles regarding synesthesia are reports of laboratory experiments, and are usually geared towards neuroscience journals with one of the goals being to beat others to the punch bowl and be the first to publish new findings. This, however, did not seem to be the focus of the proposed *T&HS* issue on synesthesia. Komendzinski agreed, and suggested that, rather than the issue trying to gather the latest “cutting edge” material, the focus should instead turn to a broad overview and analysis of research on synesthesia in numerous fields.

Consequently, the scientists who accepted our invitation to contribute to this *T&HS* special issue on synesthesia had been given certain *carte blanche* as to what and how to explicate their much cherished concerns and

insights regarding the phenomenon of synesthesia. From this emerged the overarching questions for this issue: “Why study synesthesia? What can studying synesthesia tell us, in broader terms, about the human mind and the human condition?” In this context, it has been our very special task as editors to ensure that each contribution is well-balanced in presenting both forward-looking intuition and scientific rigor, spurring momentum of debate and logical structure of argument.

Furthermore, when we set to work rounding up contributors for the issue, the goal was to be as international as possible. And that goal and the adopted strategy of contributing to the issue resulted in the anticipated outcome: an extremely diverse set of topics. Put quite simply, what we find is that there are about as many reasons to study synesthesia as there are researchers involved in the pursuit.

What is inside

While Marks and Mulvenna’s article has a main focus on the complex relations between synesthesia and metaphor, which, being diversely actualized at the levels of perception, cognition and language, play a functional role in creative transformations of meanings in our comprehension of the world, this paper also begins this series of articles by immediately introducing an essential topic: In a sense, one of the main reasons for researching synesthesia is to confront ourselves with our “centrisms”, whether one is being egocentric, ethnocentric, species-centric, or otherwise. We are looking at the question of “How do we come to understand those not us?”, in a combination culling from such diverse fields as anthropology (e.g., Chagnon 2013), to semiotics (e.g., Sebeok and Umiker-Sebeok 1992), to biology (e.g., von Uexküll 1957/1934), to philosophy (e.g., Nagel 1974). As one of us has mentioned elsewhere (Day 2013), synesthesia is not wholly, by its nature, ineffable; on the contrary, many aspects of synesthesia can indeed be readily and easily described and demonstrated. Yet, nevertheless, the one overwhelmingly predominant question on the lips of researchers, the interested public in general – and, let us not forget, due to their great diversity, also on the lips of synesthetes themselves – remains “What is it like to have synesthesia?” How do we convey alternate realities? It helps to remember that one can maintain alternate realities simultaneously. Anyone who knows the two of us editors will know that one (Day) will tend to focus here almost exclusively on epistemological approaches to these questions, while the other (Sidoroff-Dorso) will tend to remind us of the broader scope, that Nagel also seems

to accentuate the ontological “to be” in his debate-provoking question, and that this should be taken as a distinct perspective when dealing with the straddling subjectivity in synesthesia. In Marks and Mulvenna’s paper these two perspectives are shown to be capable of insightfully converging with the aim of revealing synesthesia’s embeddedness in metaphorical cognition.

Sinke et al. and Rogowska then lead us into the multitude of approaches towards addressing the question of “What are the neurological difference between synesthetes and non-synesthetes?” We know that there are such differences, at least in regards to a couple of the more commonly researched forms of synesthesia (e.g., grapheme-based and sound to color; see e.g., Rouw and Scholte 2007; Rouw et al. 2011). Sinke et al. take up the gauntlet of philosophical contemplation of neurobiological aspects of synesthesia by prioritising the top-down brain mechanism in the process of binding. Their perspective on synesthesia is delineated as a three layer model that integrates transmodal functions among which developmental synesthesia is ascribed a special and challenging role.

By juxtaposing synesthaesiae of various geneses, Rogowska puts forth a unifying model where each type of synesthesia is distinctly characterized by its causal explanation and manifest traits. In particular, language-based color-related synesthesia may reflect inborn hypersensitivity to color perception that disrupts the process of “double integration” and results in being a compensatory formation. Both Sinke et al. and Rogowska are very analytical in disentangling the reported types and varieties of synesthesia. In this regard, it seems trite to say and obvious, but we still have little knowledge of the extent of these differences, or of their implications. What we do, however, see quite clearly from the articles here is that synesthesia causation quite simply cannot be reduced to one single all-encompassing factor. It is not merely that there are different theories being debated – of course there are, since that is what good science, done properly, does – and we have not yet reached solid decisions on certain things. Rather, put simply, we now have very initial but solid foundations to state that most if not all of the wide realm of synesthaesiae have multiple causations distributed both temporally and structurally. This is an essential point – and yet still persistently ignored amongst not just the media but also amongst many researchers.

Having explored neurological differences between synesthetes and non-synesthetes, and extending this to considerations of differences between different types of synesthetes, Sidoroff-Dorso takes us to questions of how to measure and categorize differences in phenotypic expression amongst (congenital) synesthetes. In his proposal of the Synaesthesia Quotient

inventory (SynQ-i), one major thing to point out is that this is not offered as a dogmatic structure (i.e., “this is what synesthesia is, and here is how to measure it”) but, rather, as an initial framework (i.e., “we need to start somewhere, so here is a model”) placed forth with an open invitation for critique towards assisting both the scientific construct of synesthesia and the proposed measure to progressively evolve into an increasingly useful tool; we are seeking the avid and concerned reader’s feedback.

Meier moves us to the question of “What effects – if any – do synesthetic associations and perceptions have, more broad-scale, on a synesthete’s overall cognitive processing?” In doing so, Meier also addresses the prevalent question of whether synesthesia enhances creativity by going beyond synesthetes’ perceptual and mnemonic abilities into contemplating the functional advantage of an additional link that synesthesia represents in synesthetes’ semantic networks.

Melero expands upon this via a framework of embodiment, to explore how attention and emotion interplay with processing crossmodal and synesthetic cognitive constructs. Being a synesthete and neuroscientist in one, the author’s conclusions can be supported by a majority of synesthetes: synesthesia is embodied and emotion plays an essential, cementing role in it, with significant implications for synesthesia research and general understanding of the human mind.

Jewanski et al.’s article raises the question of the extent to which current synesthesia research – or, more broadly, currently neuroscience – is re-inventing wheels originally constructed more than a century ago. Our opinion on this is that we are not exactly re-inventing the wheel – new technologies, and our recent history of experiments to disprove certain hypotheses, have indeed brought us some quite new insights regarding synesthesia. Rather, it is that we fail to realize that most of the foundations we are building upon are not recent – e.g., post-Cytowic – ones, but instead were propositions held and discussed well over a century ago. There is, very unfortunately, a resurging and currently quite prevalent trend amongst synesthesia researchers – perhaps particularly the younger students, but we find it also amongst the older, post-doctoral neophytes – to look upon the whole realm of “synesthesia” as a new discovery and a virgin field. It is not, lest it be forgotten; much of the “classic” literature remains very pertinent and can still offer new insights.

De Córdoba takes us to a different dimension when addressing the question “Why study synesthesia?”: What can we then do with our accumulated research? Can this become applied science? If so, do we create trivial toys, or do we garner useful results? De Córdoba turns her attention

to pedagogy and questions of creativity. While her article looks mainly at university students, it might perhaps be appropriate to also mention here that one of the primary focuses of the recent congresses in Granada and Almeria (Spain), Ulm, (Germany), and also including the last meeting of the American Synesthesia Association (Toronto, May 31 – June 2, 2013), was to address questions regarding pedagogy and synesthesia (perhaps, most specifically, pedagogic techniques for interacting with synesthetes) for adolescents in grade schools.

There is a now rapidly emerging corpus of material being assembled for educators and school administrators in many countries. Van Campen is one such researcher currently focusing on synesthete children and pedagogy, and offers his findings here. According to van Campen, synesthesia awareness should be regarded as an active process rather than occasional event and, therefore, needs to be one of the primary concerns of developmental psychologists and educators.

Spence and Deroy, however, take the question of practical applications of synesthesia research in a different direction by exploring the boundaries between synesthesia and more generalized crossmodal associations, as they apply in more commercial industries such as in plating restaurant menu items or in supermarket beverage sales. This once again raises questions about the extent of cultural impact on shaping crossmodal associations, and thus the extent of cultural impacts on synesthesiae also.

We end our issue with a rare, special treat: an exclusive interview with Richard E. Cytowic. Cytowic, perhaps more than anyone else, is responsible for re-introducing synesthesia research, abandoned decades earlier, with his groundbreaking *Synesthesia: A union of the senses* (1989) and *The man who tasted shapes* (1993).

(Day: I remember very distinctly the day in 1989 when Cytowic's book hit the local book store I frequented, two or three blue-jacketed copies from the neuropsychology series standing out amongst a new shipment, just in that morning, of dozens of yellow-jacketed books on mathematics from Springer Verlag. Being a synesthete myself, and by then familiar with the term "synesthesia", I was stunned and my jaw almost hit the floor as my eyes glanced upon that title. I grabbed my copy immediately, and devoured it in the next few days.)

Cytowic very graciously agreed to answer a set of questions. We present the views of an eminent scientist – and dear friend – who built a major part of his career upon addressing the question "Why study synesthesia?", and who can now reflect back over more than 25 years of evolution in his

responses, as he brings us to focus on our current reasons and needs for continuing in this pursuit.

If we turn to the question of broader-term relevance of synesthesia research beyond the areas just focused upon in this issue ... Well, we have such things as Banissy and Ward's (2013) recent study of mirror-touch synesthesia, which can be pulled into analyses and critiques of Michael Arbib's (2012) theories regarding the roles of mirror neurons in the evolution of human language. Then we also have Baron-Cohen et al. (2013) and Neufeld et al. (2013), who raise the question of the extent of synesthesia amongst those on the autistic spectrum, proposing that the synesthesia in this group might be, in effect, a spandrel of the more broad-scale hyper-connectivity resulting in autism. And the topic of hyper-connectivity then may lead us back to such items as Gregersen et al.'s (2013) recent study, further exploring the similarities between absolute pitch as certain forms of synesthesia, a topic also being explored by Zamm et al. (2013). A special note should also be taken of Luke and Terhune's review of synesthesia with chemical agents (2013) as well as Carmichael and Simner's immune hypothesis (2013). To break the isolationist and inward-looking stance of traditional approaches, we should also mention the promising research by Bargh on the automaticity of higher mental processes (e.g., Bargh and Ferguson 2000; Hassin et al. 2005), Karmiloff-Smith's neuroconstructivism (1992; Mareschal 2007), Barsalou's research into the groundedness of the human conceptual system in the brain's modal systems for perception, action, and introspection (e.g., Barsalou and Wiemer-Hastings 2005; Barsalou 2013) as well as studies of the interaction between higher-order and lower-order mechanisms in cognitive functions (see in Droege 2003; also Goldstone 2003; Terai and Goldstone 2012).

However, the reader's understanding of today's synesthesia research might be incomplete without the reinvigorating ideas and innovative tools provided in this issue of *T&HS*, which is charting a course into the new or underexplored territories and will definitely give an up-to-date, we dare say, futuristic map of the inroads to answering the question "What can studying synesthesia tell us about the human mind and the human condition?"

Theoria et Historia Scientiarum, based in Poland, is a very international publication. This issue on synesthesia collects work from researchers in Germany, the Netherlands, Poland, Russia, Spain, Switzerland, the United Kingdom, and the United States of America. Yet, sadly, there is no representation here from all of South and Central America, nor from all

of Africa, nor from India or East Asian countries such as China or Japan, nor from Indonesia, Australia or New Zealand. This, of course, has numerous reasons. It is one of our main hopes, however, that this issue is read and generates new research on synesthesia in other regions of the world.

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