

Object Sexuality and Spectrum Autism

Object sexuality or objectophilia involves individuals developing deep emotional attachments to specific inanimate objects or structures with which they can have friendships or romantic relationships (known as objectophiles). For example, in 1979, Eija-Riitta Eklöf, a model-builder, gained the first media attention for this orientation by marrying the Berlin wall (Marsh, 2010). In 2006, Erika Eiffel held a commitment ceremony with the Eiffel Tower, which was prominently featured in the media, to, as she says “honor my love for Bridges as La Tour Eiffel was dubbed the “Sheppardess of the Bridges” and engineered by one of the world’s greatest Bridge engineers, Gustave Eiffel.” Erika found herself drawn to the bridges of late 1800 and early 1900 since she was a child. She describes been heartbroken at the age of 15 when her favorite Fairbanks bridge collapse: “the pain that consumed me was taken as a foolish obsession so I buried my broken heart as the sands of the river buried the remains of my Fairbanks Bridge.”

How should this phenomenon be explained? In what follows I propose and evaluate several hypotheses. I argue that the last hypothesis is the most likely explanation for object sexuality.

Hypothesis 1: Object-sexuality could be described as a type of synesthesia. The term ‘synaesthesia’ is an umbrella term that encompasses a spectrum of a relatively rare neurologically-based condition in which the stimulation of one sensory or cognitive pathway (called the inducer) elicits atypical automatic, involuntary, and consistent experiences in the same or another sensory or cognitive pathway (called the concurrent) (Cytowic, 1989/2002; Baron-Cohen and Harrison, 1997; Day, 2005; Cytowic and Eagleman, 2009; Banissy & Ward, 2007; Smilek et al., 2007). For example, graphemes, sounds, or tastes can trigger colour experiences or feelings of touch.¹

Traditionally, synesthesia has been described as a phenomenon involving inducer-concurrent experiences that are highly specific (which may or may be perceptual in nature if we were to include strong and weak forms), automatic (i.e., they cannot be turned on or off at will) and consistent over time (i.e., they tend to be present since early childhood), and are thought to have a genetic bases (Asher et al., 2009). Synesthesia has been divided into two categories: projector and associator. Both of these categories describe a condition in which an inducer in one modality elicits an atypical concurrent in the same or another modality. However, the distinction is used to highlight the way the concurrent is experienced. In the former category, a concurrent is experienced as projected outward, which has led some researchers to claim that the former is an experiential phenomenon (Ramachandran and Hubbard, 2003; although see Brogaard, 2014).² In the latter category a concurrent is experienced internally, in the ‘mind’s eye’ as it were. Synesthetes in the former category are called ‘projectors’, while in the latter, they are called ‘associators’ (Dixon, Smilek, & Merikle, 2004).³

¹ Sean Day lists as many as eighty different types of synesthesia (see <http://www.daysyn.com/types-of->

² Rich & Mattingley (2014) argue that there is continuum between associators and projectors.

³ A distinction between ‘strong’ and ‘weak’ synesthesia has also been made (see Martino and Marks, 2001; Day, 2016). However, this classification is seen as problematic because weak/cognitive/pseudo synesthesia includes crossmodal phenomena lacking conscious concurrents, a core feature of synaesthesia (see Spence, 2011; Deroy and Spence, 2013). This distinction has led to three types of theoretical frameworks, monism, dualism, and pluralism, which have been used to characterize the relation between strong/proper/genuine and weak/cognitive/pseudo synesthesia (see Marks, 2011; Marks and Mulvenna, 2013). Synesthetic monists maintain that synesthesia is best construed as a spectrum or continuum, with strong/proper/genuine synesthesias residing at the high end of the continuum and weak/cognitive/pseudo synesthesias at the low end. Synthetic dualists and pluralists maintain that there is a sharp distinction between strong/proper/genuine and weak/cognitive/pseudo synesthesias. However, synesthetic pluralists also posit that synesthesia is well characterized as a “teeming multiplicity” (see

Three types of theoretical frameworks, monism, dualism, and pluralism, have been outlined as a way to characterizing the relation between synesthesia and other borderline perceptual and conceptual phenomena (Marks, 2011; Marks and Mulvanna, 2013). Synesthetic monists maintain that synesthesia is best construed as a spectrum or continuum, with synesthesias residing at the high end of the continuum and weak synesthesias residing at the low the low end. Synthetic dualists and pluralists explicitly distinguish between synesthetic (which include strong and weak synesthesias) and non-synesthetic experiences (which include cross-modal imagery or hallucinations). However, synesthetic pluralists also posit that synesthesia is well characterized as a “teeming multiplicity” (Marks, 2014). Given the variety of synesthesias, it has been suggested that that synesthesia involves distinct underlying mechanisms and different genetic bases (Novich, Cheng, & Eagleman, 2011; although see Marks and Mulvanna, 2013).

Two types of synesthesias seem relevant here. The first is sexual synesthesia, which typically refers to individuals in whom sexual activity sexual activity such as kissing or sexual intercourse triggers, among other things, color experiences, tastes, or shapes (Cytowic, 1989). Sexual synesthesia is identified by inducer-concurrent pairs where the inducer is typically a sexual activity such as touching, kissing, or intercourse is the inducer and the synesthetic experience (including colors, flavors, smell, sounds, or temperatures) is the concurrent. Object-sexuality differs from sexual synesthesia in that objectophiles do not experience inducer-concurrent pairs characteristic of sexual synesthesia. Although they may be sexually aroused by an object, their experience bears more similarity to typical experiences people have towards their loved ones or their pets than synesthetic experiences. Here’s how BC Hall, a self-ascribed objectophile, describes the relation between objectophiles and their objects:

...just because we state that we have `sex' with an object does not mean that the way we have sex is anything like the way that humans have sex. For instance, an OS woman does not necessarily have to be penetrated to be having sex; a lot of OS sex is based on an emotional intimacy. Now, don't get me wrong. There are those that are very physically sexual with their objects, but for me personally, it is a psychic connection, an energy transfer in addition to kissing, cuddling, and other such `above-the-waist' displays of affection that defines what I mean when I say that my partners and I have sex. (<http://www.objectum-sexuality.org>)

Moreover, there is anecdotal evidence that those who are physically sexual with their objects tend to experience enhanced sexual satisfaction even when they think or see a specific object or a representation of it (e.g., a photograph or a model of the said object). Sexual synesthetes, by contrast, do not experience increased degree of sexual satisfaction (Nielsen et al., 2013).

Hypothesis 2: Object-sexuality is not a type of sexual synesthesia *per se* but it is causally related to synesthesia. Two candidates are most relevant here: object-personality and mirror synesthesias. I will discuss each in turn. It has been suggested that object-sexuality may be causally related to object-personality synesthesia (Marsh, 2010). The suggestion is that object sexuality results from object-personality synesthesia leading to the formation of emotional or sexual responses towards them. Object-personality synesthesia involving inanimate objects eliciting personality traits. For example, one object-personality synesthete, TE, experiences inanimate objects, including numbers and letters, as having vivid, complex personalities (Smilek et al., 2007: 981):

Three is male; definitely male. Three is such a jerk! He only thinks of himself. He does not care about any other numbers or anything. All he wants is to better himself and he'll use any sneaky, underhanded means necessary. But he's also pretty young; he doesn't understand anything and

Marks, 2014). For a defense of a separatist view, which treats synesthesia and crossmodal correspondences as distinct phenomena see Deroy & Spence, 2013.

he doesn't have very much power, as far as social status is concerned. So, he tries to hang out with Eight (who's also a bad number) just so that he can feel better about himself. But really, none of the numbers can stand him. He's a real jerk. He'll pretend as though he's your friend, but then he'll manipulate you and stab you in the back if he feels he can gain something from it. Then he'll never speak to you again. If Three had parents, even his parents would hate him. It's not as though what he does has some purpose or something behind it, he's just a really nasty number. He just wants things for himself. He doesn't care in what he does. If he had a voice, it wouldn't be high-pitched, but it wouldn't be deep. It'd be on the high side, a very annoying voice. He'd be short and very thin; very annoying.

TE is not an exemplar object-personality synesthete since the experiences of most object-personality synesthetes are less vivid or detailed. Nevertheless, object-personality synesthetes tend to attribute personalities as well as emotions or motives to inanimate or objects (Sobczak-Edmans and Sagiv, 2013). And although most humans tend to anthropomorphize inanimate objects, e.g., ascribing a gender to a car, animated objects (Heider & Simmel, 1944), or animals, these cases differs from object-personality synesthesia since they do not involve vivid, automatic, or consistent inducer-concurrent pairs.

Although objectophiles attribute personalities to the objects of their affection, a survey of twenty-one subjects indicated that they do not experience object-personality synesthesia. Instead objectophiles tend to talk about their objects as having a 'soul', and sometimes, a 'persona'. Here's how Eva K. and Rudi (respectively) both self-ascribed objectophiles, describe their experiences:

My dearly loved words, names, or phrases have a soul, an essence; I even dare to say they have a persona. They have colours, landscapes, or wordscape as I like to say. Atmospheres... Words, names or phrases are intangible and abstract subjects so of course we can't think in terms of love-making between humans. However it is possible for me to love them through the making of graphic creations. I usually design my own artworks with the words, sentences, or names I love.

...through my life-time I have learned that an object has got a soul. I was mourning the loss of an object for very long and my life was senseless, joyless. Soon it was pretty clear for me, that something that had no soul could not scratch such a big hole into my soul with its loss. When something touches your body, it must have a body too. When something touches your soul, it must have a soul. (<http://www.objectum-sexuality.org>)

Unlike TE, the object-synesthete described by Smilek and his colleagues (2007), Eva is not experiencing objects (in TE's case graphemes) as having distinct personalities. She, like Rudy, feels an attraction, and even reverence, towards an object.

The second type of synesthesia that is relevant here is mirror-synesthesia. Functional imaging suggests the existence of mirror systems in humans for actions, sensations, and emotions (Gallese et al., 1996; Buccino et al., 2001; Blakemore et al., 2005; Wicker et al., 2003; Banissy & Ward, 2007). For example, observing an agent grasping or manipulating an object triggers mirror neurons. A somatotopically-organized activation during observation of object-related actions, was found in the posterior parietal lobe suggesting that when individuals observe an action, an internal representation of that action is automatically generated in their premotor cortex (Buccino et al., 2001). The mirror-neuron system—comprising premotor cortex, superior temporal sulcus, and parietal cortex—forms a system for matching observation and execution of motor actions (Gallese et al., 1996; Buccino et al., 2001). It has been suggested that one possible function of the mirror-neuron system is to enable organisms to detect certain mental states of observed conspecifics, and which may be a part of a more general mind-reading ability (Gallese & Goldman, 1998).

Mirror-synesthesia is described as a type of synesthesia in which visual perception of tactile sensations or emotions elicits conscious tactile or emotional experiences in the observer (Gallese & Goldman, 1998; Blakemore et al., 2005). For example, the observation of another person being touched can be experienced as a tactile stimulation on the equivalent part of one's own body. Or observing an emotion such as disgust or pain can elicit the same emotional or empathetic response (Wicker et al., 2003; Banissy & Ward, 2007). Mirror-synesthesia has been attributed to the overactivity of the mirror-neuron system, i.e., the overactivity is above the threshold for conscious tactile perception (Blakemore et al., 2005).

Can object sexuality be attributed to mirror-synesthesia? The suggestion here would be that object sexuality results from the mirror-synesthesia, which then leads to the formation of emotional or sexual responses towards them. However, there is no evidence to suggest that objectophiles experience higher levels of mirror-synesthete than the rest of the population. It may be argued, nevertheless, that the mirror-neuron system in humans (and other mammals) can be triggered in non-synesthetes. So even though objectophiles may not have mirror-synesthesia, they may nevertheless have an overactive mirror-neuron system. This, however, is also problematic since research suggests that the object alone (or the action alone) is insufficient to activate the mirror-neuron system. The activation of the system requires an interaction between the act of manipulating or grasping and the object of that act (Gallese et al., 1996). Objectophiles are attracted to the object itself, or multiple objects at the same time. Their attraction does not involve others interacting, e.g., grasping or manipulating, with the object of their affection. Visually seeing the object or a representation (i.e., a picture or a model of it) as well as imagining or thinking about an object elicits emotional or sexual responses. For this to happen, the mirror-neuron system need not be overactive, or even active.

Hypothesis 3: The above discussion suggests that objectophilia cannot be attributed to synesthesia. However, it may be related to another far more prevalent phenomenon, viz. crossmodal mental imagery, which occurs when a physical (or imagined) presentation of a stimulus in one sensory modality elicits a mental image in another modality (Spence & Deroy, 2013a) such as a sound inducing a tactile mental image (Kitagawa and Igarashi, 2005).⁴ Crossmodal mental imagery involves crossmodal correspondence, which is prevalent in non-synesthetic experiences (Spence, 2011). For example, although music-color synesthetes see⁵ brighter colors when they hear high-pitched notes (Mulvenna and Walsh, 2005), non-synesthetes exhibit consistent crossmodal correspondences between high-pitched sounds and small, bright objects located high up in space (Spence, 2011; Deroy and Spence, 2013a). And although there are similarities between crossmodal sensory synesthesia and crossmodal mental imagery (e.g., both are considered to involve conscious, vivid concurrents in the absence of the appropriate

⁴ Deroy and Spence (2013a) use the term 'multisensory' to refer to cases in which one imagines having, say, a conversation with one's best friend. This example involves stimuli in two different modalities, i.e., auditory and visual, which are combined in the representation of a single event.

⁵ Brogaard (2014) identifies three different kinds of conscious states of seeing denoted by the English verb 'to see': *visual experiences*, *introspective seeming states*, and *visual seeming states*. Visual experiences are veridical and stand in a non-deviant causal relation to the state of affairs represented by them while visual and seeming states are neither strictly veridical nor experiential but are more common. Introspective seemings introduce a hyperintensional context. For example, substituting 'superman' with 'Clark Kent' fails to preserve its truth-value of Lois Lane's utterance "This drug is really strong! I see superman all over the place" made under the influence of a strong hallucinatory drug. Synesthetic experience, according to Brogaard, is a kind of visual seeming since it involves the cognitive processing of a stimulus, e.g., a number, prior to experiencing it as having a synesthetic color. For example, some synesthetes experience different synesthetic colors in ambiguous contexts such as when a grapheme could be interpreted either as a number or a letter (Cytowic & Eagleman 2009). The term 'see' here refers to this last conscious state, a visual seeming state.

sensory input), only the former is characterized by regular inducer-concurrent pairs (Deroy and Spence, 2013a).

How can objectophilia be explained in terms of crossmodal mental imagery? One possibility is that seeing or hearing an object elicits mental images of, say, touch, which is reinforced over time leading to feelings of attachment or sexual attraction. However, there is currently no evidential support for this hypothesis (although see below for evidence against it). And even if evidence suggested that crossmodal mental imagery occurs among objectophiles, this alone would not explain why only some objects elicit the appropriate mental imagery. For example, objectophiles tend to be attracted to various objects within a specific class, e.g., bridges, trains, buildings, etc. Perhaps, some objects come to have more significance than others, thereby giving rise to the appropriate mental imagery, as a result of fetishes acquired in early childhood.

Although it may be tempting to treat objectophilia as a form of fetishism, there are several crucial differences between the two. Fetishism centers on the use of inanimate objects as a source of sexual satisfaction or the fulfillment of sexual fantasies or urges. There are two types of inanimate object fetishes: form and media. In a form fetish, what is important is the form of an object. For example, a high-heeled shoe fetish is often related to the shape or form of the shoe. In a media fetish, it is the material of an object that is important. For example, a leather fetish is often related to the smell or the material of the leather. Fetishists use objects exclusively as the means of achieving sexual satisfaction. The focus is exclusively on the fetish, not on the object itself, while the sexual satisfaction tends to be associated with the feeling of power over the object. As a result, the sexual acts of fetishes are characteristically depersonalized and objectified. Objectophiles too can experience sexual satisfaction when they think or come into contact with the object or a representation of it, e.g., a model or picture. However, the focus is on the object and its qualities, not on some fetish. As a result, the attraction of objectophiles is not purely sexual, depersonalized, objectified, or derived from feeling a sense of power over the object. In addition, while most fetishes are associated with parts of the body such as amputee, breast, or foot, or things that can be worn such as gloves, leather, or spandex, objectophilia is not associated with body parts or things that can be worn. More importantly, most fetishes tend to be visual as well as more prevalent among males, presumably because males tend to be more sexually sensitive to visual stimuli than females (Darcangelo, 2008). Objectophilia, by contrast, is not more prevalent among males.

Hypothesis 4: The most likely hypothesis is related to Asperger's syndrome. Twelve out of twenty-one objectophiles surveyed were diagnosed (five and one of autism), identified (four), or have been described by others (three) as having Asperger's Syndrome (Marsh, 2010). This suggests a link between objectophiles and Asperger's Syndrome, a condition within the autism spectrum. Asperger's Syndrome tends to be under-diagnosed in adults because it did not enter the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) until 1994. A new documentary, titled "Off the Rails," sheds light to the objectophilia of an Asperger's man, Darius, who is in love with trains.

Asperger's Syndrome is characterized by a restricted range of interests and difficulty with social interaction and nonverbal communication (Bashe & Kirby, 2001; Attwood, 2015). Most of the objectophiles surveyed by March (2010) had no romantic or sexual relationships with other humans and expressed no desire to experience them. Only two objectophiles reported having a sexual human relationship. De Silva and Pernet (1992) describe an objectophile, George who feels sexual attraction to Austin Metro cars, as shy, lacking in social skills, having few friends and no social life. This suggests that certain objects may serve as special interests for objectophiles who have difficulties with social interactions with other human and nonverbal communication. One objectophile describes her lack of interest in romantic interactions and her love for words:

For me romantic relations with humans are just out of the question. I have never felt any sexual /physical or erotic magnetism to people.

My deep love for the written word involves a very sophisticated and most delicate fine tuning which is comparable to experiencing music or art... During my life there must have been over 50 very special words and names I was madly... passionately in love with.

There are two competing theories, The theory of Mind and The Intense World Theory, which purport to explain the antisocial behavior exhibited by autistic individuals. Both of these theories are consistent with this hypothesis.

According to The theory of Mind (TOM) prevalent theory posits that autistic individuals exhibit antisocial behavior because they are severely impaired in reading other people's minds and thus lack the ability to share the feelings of another (a behavior that has been attributed to the hyper-functioning of the amygdala) (Baron-Cohen, Leslie, & Frith, 1985; Baron-Cohen et al., 2000). TOM posits that autistic individuals lack the ability to attribute mental states to themselves or others as well as distinguish between theirs and other minds. As a result, they are unable to express appropriate emotional responses or empathize with others, which purports to explain the deficits in social interactions, including inappropriate responses in social encounters even in high-functioning forms of autism such as Asperger (for a review see Markram, Rinaldi, and Markram, 2007). TOM, therefore, explains why objectophiles tend to avoid sexual human relationships.

The Intense World Theory (IWT), seems provides another explanation for the phenomenon of objectophilia. According to IWT, autism is linked to the hyper-functioning of elementary brain modules (known as local neural microcircuits), which are characterized by hyper-reactivity and hyper-plasticity (Markram and Markram, 2010). Hyper-functional microcircuits become easily autonomous, leading to runaway information processing, over-specialization in tasks, and hyper-preference syndrome. The core cognitive consequences of hyper-functioning include *hyper-perception*, *hyper-attention*, *hyper-memory*, and *hyper-emotionality*. Hyper-emotionality seems to be particularly relevant for object-sexuality since it explains the avoidance or lack of interest in human relations and the need to connect with inanimate objects. According to IWT, autistic individuals exhibit antisocial behavior because they are not able to process socio-emotional cues sufficiently as other theories have suggested (see, e.g., Baron-Cohen et al., 1999). Rather, autistic individuals exhibit enhanced perception, attention, and memory capabilities, which make their experiences too intense and even aversive leading to social avoidance and withdrawal. This hyper-reactivity may, therefore, explain their preference of inanimate objects, which would be experienced far less intense. The assumption that the world appears too intense for many such individuals, would also explain why they report that they experience objects as having "souls" or "spirits" -- it is possible that objects excite their senses enough to appear alive. The IWT predicts that autistic individuals may experience strong imprint of early life experiences, which coupled with the hyper-reactivity, may explain why in objectophiles the affinity for objects occurs very early in life. For example, Erica Eiffel reports that she found bridges very attractive from a very young age; Eija-Riitta Berliner-Mauer, reports falling in love with the Berlin Wall when she first saw it on television when she was seven years old; and Adam M., reports that he feels so emotionally and spiritually close to his 1997 Saturn SWI Station Wagon, Nina, that he considers her his wife. Perhaps, objectophilia can be learned in a similar way that synesthetic pairings can be learned -- for example, a recent study found that over 6500 people learned to associate colors with letters from a toy produced between 1970 and 1990 (Witthoft, Winawer, & Eagleman, 2015; see also Colizoli, Murre, & Rouw, 2012).⁶ The objects

⁶ This does not entail that those who are trained to associate words and colors do not differ functionally from word-color synesthetes. Studies show activation in brain regions involved in the processing of colors (i.e., V4/V8) in word-color synesthetes, i.e., synesthetes who experience colors when hearing words,

objectophiles tend to be attracted to seem to be objects they come into contact from a very young age. This attraction to objects develops from perceptions or interactions with them, which would explain why objectophilia does not result from sexual trauma: objectophiles are not attracted to objects because they have been traumatized by humans but rather because human interactions are too intense to be enjoyable.

Amy March (2010) suggests that object-personality associated with Asperger Syndrome may explain the attraction to certain objects:

if a person senses a pleasing personality in, say, a teapot – it is logical that a person may develop warm feelings for that object, and warm feelings may grow even warmer over time. Humans, being what they are, are capable of eroticizing nearly anything.

She notes that this conclusion is consistent with the fact that synesthesia is also known to be more prevalent among people with Asperger. However, although shared genetic components associated with differences in brain anatomy such as local connectivity and altered cognitive mechanisms (e.g., veridical mapping and a greater tendency to concretize abstract information) may make Asperger patients more likely to have (color-grapheme) synesthesia (Neufeld, 2013), objectophiles do not seem to experience the inducer-concurrent pairs characteristic of synesthesia. It is, therefore, unlikely that what attracts them to objects is related to synesthesia. The prevalence of Asperger among objectophiles also makes it unlikely that objectophilia can be explained in terms of crossmodal mental imagery. Studies show that while autistic children engage in repetitive behavior but not in spontaneous pretend play, autistic adults tend to show little interest in fiction (Carpenter, Tomasello, and Striano 2005; Rogers, Cook, and Meryl 2005). This suggests that it is very unlikely that sensory experiences of object elicit mental imagery, which leading to feelings of attachment or sexual attraction. What is more likely is that autism makes romantic or sexual relations with humans too intense to be enjoyable. This coupled with preoccupations with certain objects may give rise to a deep connection, which then translates into, among other things, sexual attraction. This hypothesis is the most scientifically accessible explanation. Future studies can be used to test it. Such studies could enhance our understanding of objectophilia and eliminate the prevalent prejudicial attitudes that make it socially unacceptable.

References

Asher, J. E., Lamb, J. A., Brocklebank, D., Cazier, J-B., Maestrini, E., Addis, L., Sen, M., Baron-Cohen, S., Monaco, A. P. (2009) A Whole-Genome Scan and Fine-Mapping Linkage Study of Auditory-Visual Synesthesia Reveals Evidence of Linkage to Chromosomes 2q24, 5q33, 6p12, and 12p12. *The American Journal of Human Genetics* 84: 279–285.

(Nunn et al., 2002) but not in non-synesthetes trained to associate words with colors (Hubbard et al., 2005). This also suggests that synesthesia is not the result of top-down processing.

Attwood, T. (2015) *The Complete Guide to Asperger's Syndrome: A Guide for Parents and Professionals*. London (Philadelphia): Jessica Kingsley Publishers.

Baron-Cohen, S., Ring, H. A., Bullmore, E. T., Wheelwright, S., Ashwin, C., and Williams, S. C. (2000) The amygdala theory of autism. *Neurosci. Biobehav. Rev.* 24, 355–364.

Baron-Cohen, S., Ring, H. A., Wheelwright, S., Bullmore, E. T., Brammer, M. J., Simmons, A., and Williams, S. C. (1999) Social intelligence in the normal and autistic brain: an fMRI study. *Eur. J. Neurosci.* 11:1891–1898.

Baron-Cohen, S., Leslie, A. M., and Frith, U. (1985) Does the autistic child have a “theory of mind”? *Cognition* 21, 37–46.

Bashe, P. R. and Kirby, B. L. (2001) *The Oasis Guide to Asperger Syndrome: Advice, support, Insight and inspiration*. New York: Crown.

Blakemore, S. -J., Bristow, D., Bird, G., Frith, C. and Ward, J. (2005) Somatosensory activations during the observation of touch and a case of vision–touch synaesthesia. *Brain* 128: 1571-1583. doi:10.1093/brain/awh500

Buccino, G., Binkofski, F. Fink, G. R., Fadiga, L., Fogassi, L., Gallese, V., Seitz, R. J., Zilles, K., Rizzolatti, G. and Freund, H.-J. (2001) Action observation activates premotor and parietal areas in a somatotopic manner: an fMRI study. *European Journal of Neuroscience* 13: 400-404.

Carpenter, M., Tomasello, M., and Striano, T. (2005) Role Reversal Imitation and Language in Typically-Developing Infants and Children with Autism. *Infancy* 8: 253-78.

Colizoli, O. Murre, J. M. J., and Rouw, R. (2012) Pseudo-Synesthesia through Reading Books with Colored Letters. *PLoS One* 7(6): e39799. doi: 10.1371/journal.pone.0039799.

Cytowic, R. E. (1989). *Synesthesia: A Union of the Senses*. New York, NY: Springer.

Darcangelo, S. (2008) Fetishism: Psychopathology and Theory. In Laws, D. R. and O'Donohue, W. T. (Eds.) *Sexual Deviance: Theory, Assessment, and Treatment* (2nd edition). New York: The Guilford Press.

Day, S. A. (2016) *Synesthetes: a handbook*. CreateSpace Independent Publishing Platform.

Deroy, O. and Spence, C. (2013a) Crossmodal Mental Imagery. In Lacey, S. Lawson, R. (Eds.) *Multisensory Imagery*. New York Springer (pp. 157-183).

Deroy, O. and Spence, C. (2013) Why we are not all synesthetes (not even weakly so). *Psychon Bull Rev.* 20(4): 643-64. doi: 10.3758/s13423-013-0387-2.

De Silva, P. and Pernet, A. (1992). Pollution in ‘Metroland’: An unusual paraphilia in a shy young man. *Sexual and Marital Therapy* 7(3): 301-306.

Dixon, M. J., Smilek, D., and Merikle, P. M. (2004). “Not all synaesthetes are created equal: projector versus associator synaesthetes”, *Cogn. Affect. Behav. Neurosci.* 4: 335–343.

Gallese, V., Fadiga, L., Fogassi, L., Rizzolatti, G. (1996) Action recognition in the premotor cortex. *Brain* 119(Pt 2): 593-609.

Gallese, V. & Goldman, A. (1998) Mirror neurons and the simulation theory of mind-reading. *Trends Cogn Sci.* 2(12): 493-501.

Gertner, L., Arend, I., & Henik, A. (2013) Numerical synesthesia is more than just a symbol-induced phenomenon. *Frontier in Psychology* 4: 860. doi: 10.3389/fpsyg.2013.00860

Heider, F., and Simmel, M. (1944) An experimental study of apparent behavior. *American Journal of Psychology* 57: 243–259.

Hubbard, E. M., Cyrus Arman, A., Ramachandran, V. S. and Boynton, G. M. (2005) Individual differences among grapheme–color synesthetes: Brain–behavior correlations. *Neuron* 45, 975–985.

Kitagawa, N., and Igarashi, Y. (2005) Tickle sensation induced by hearing a sound. *The Japanese Journal of Psychonomic Science* 24:121–122.

Mulvenna, C. M., and Walsh, V. (2005) Synaesthesia. *Curr. Biol.* 15: 399–400. doi: 10.1016/j.cub.2005.05.039

Markram, K., Rinaldi, T., and Markram, H. (2007) The intense world syndrome – an alternative hypothesis for autism. *Front. Neurosci.* 1:1. doi: 10.3389/neuro.01/1.1.006.2007.

Markram, K. and Markram, H. (2010) The Intense World Theory – a unifying theory of the neurobiology of autism. *Frontiers in human neuroscience* 4:224. doi: 10.3389/fnhum.2010.00224

Marks, L. E. (2014) Synesthesia: A teeming multiplicity. In Etzel Cardeña, Steven Jay Lynn and Stanley Krippner (Eds.) *Varieties of anomalous experience: Examining the scientific evidence* (2nd ed.) (pp. 79-108). Washington (DC): American Psychological Association.

Marks, L. E. (2011). Synesthesia: then and now. *Intellectica* 55: 47–80.

Marks, L. E. and Mulvenna, C. M. (2013) Synesthesia, at and near its borders. *Front. Psychol.* 4:651. | <http://dx.doi.org/10.3389/fpsyg.2013.00651>

Marsh, A. (2010) Love among the objectum sexuals. *Electronic Journal of Human Sexuality* 13. <http://www.ejhs.org/volume13/ObjSexuals.htm>

Martino, G. and Marks, L. E. (2001) Synesthesia: Strong and Weak. *Current Directions in Psychological Science*, 10(2): 61-65.

Neufeld, J., Roy, M., Zapf, A. Sinke, C., Emrich, H. M., Prox-Vagedes, V., Dillo, W., Zedler, M. (2013) Is Synesthesia more common in patients with Asperger Syndrome? *Frontiers in Human Neuroscience* 7:847. doi: 10.3389/fnhum.2013.00847

Novich, S., Cheng, S. and Eagleman, D. M. (2011) Is synaesthesia one condition or many? A large-scale analysis reveals subgroups. *Journal of Neuropsychology* 5: 353–371.

Nunn, J. A., Gregory, L. J., Brammer, M., Williams, S. C., Parslow, D. M., Morgan, M. J., Morris, R. G., Bullmore, E. T., Baron-Cohen, S., Gray, J. A. (2002) Functional magnetic resonance imaging of synesthesia: Activation of V4/V8 by spoken words. *Nat. Neurosci.* 5(4): 371-375.

Ramachandran, V. S. and Hubbard, E. M. (2003). The Phenomenology of Synaesthesia. *Journal of Consciousness Studies* 10: 49-57.

Rich, A. N., Mattingley, J. B. (2014) The role of attention in synaesthesia. In Simner J, and Hubbard E (eds). *The Oxford Handbook of Synaesthesia*. Oxford, UK: Oxford University Press.

Rogers, S., Cook, I., and Meryl, A. (2005) Imitation and Play in Autism. In F. R. Volkmar, R. Paul, A. Klin, and D. Cohen (Eds.) *Handbook of Autism and Pervasive Developmental Disorders*. New York: Wiley (pp. 382-405).

Simner, J. and Hoenes, E. (2007) Ordinal Linguistic Personification as a Variant of Synesthesia. *Journal of Cognitive Neuroscience* 19(4): 694-703.

Smilek, D., Malcolmson, K. A., Carriere, J. S. A., Eller, M., Kwan, D., & Reynolds, M. (2007). When “3” is a Jerk and “E” is a King: Personifying Inanimate Objects in Synesthesia. *Journal of Cognitive Neuroscience* 19: 981-992.

<https://www.ncbi.nlm.nih.gov/pubmed/17536968>

Sobczak-Edmans, M. and Sagiv, N. (2013) Synesthetic Personification: The social world of graphemes. In Julia Simner and Edward Hubbard (Eds.) *Oxford Handbook of Synesthesia*. Oxford: Oxford University Press.

Spence, C. (2011) Crossmodal correspondences: a tutorial review. *Atten. Percept. Psychophys.* 73(4): 971-995. doi: 10.3758/s13414-010-0073-7

Witthoft, N., Winawer, J., Eagleman, D. M. (2015) Prevalence of Learned Grapheme-Color Pairings in a Large Online Sample of Synesthetes. *PLoS ONE* 10(3): e0118996. doi:10.1371/journal.pone.0118996

Wicker, B., Keysers, C., Plailly, J., Royet, J. P., Gallese, V., Rizzolatti, G. (2003) Both of us disgusted in My insula: the common neural basis of seeing and feeling disgust. *Neuron* 40(3): 655-64.

