

SYNESTHESIA AND CREATIVITY:  
AN ANALYSIS OF HUMAN PERCEPTION

By

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## Abstract

Synesthesia is a neurological condition in which the stimulation of one sensory or cognitive pathway leads to the automatic stimulation of a second pathway. Synesthesia can create a new form of perception that heightens the senses. Though there are a variety of studies on synesthesia characterizing it, distinguishing different types, and discovering the benefits it may offer, one of these main hypothesized benefits of synesthesia is enhanced creativity. In analyzing paintings from three synesthetic artists, Van Gogh, Kandinsky, and Munch, using an art historical lens, it can be seen how each of their synesthetic conditions heavily influenced their portrayal of personal sensation in art.

In Part I of this thesis, I conducted a literature review to test my hypothesis that synesthesia is associated with improved creativity. The studies reviewed applied a variety of synesthesia tests to determine the type and extent of the synesthetes' abilities, and different tests to quantify their creativity. The results from each of these studies support the hypothesis that synesthesia heightens creative abilities.

In Part II, I analyzed data from young adult participants who voiced their thoughts in a Think Aloud Task under two conditions: an unprompted condition meant to capture spontaneous thought and one answering a creativity prompt. The participants self-rated the extent of their visual imagery while independent raters scored their overall creativity. In the creativity-specific task, increased visual imagery across participants predicted higher creativity scores.

Additionally, one participant in the study self-reported being synesthetic and scored notably higher in both visual imagery and overall creativity than the average participant.

In understanding the inner workings of synesthesia and its link to creativity, we can broaden our understanding of human perception.

## **Introduction**

Synesthesia is an incredible phenomenon “in which stimulation of one sensory or cognitive pathway leads to involuntary experiences in a second sensory or cognitive pathway,” (Cytowic, 2002). This neuronal “cross-talk” leads to experiencing combinations of otherwise unrelated percepts such as associating colors with numbers or letters or sounds with visual sensations. “Cross-talk” is used to define the phenomenon of when perceived stimuli become mixed during transmission, resulting in the mixing of pathways and the combination of senses. This occurrence is said to result in enhanced mental images and a richer world of experience (Meier & Rothen, 2013). Synesthesia can often be seen in famous artists such as Vincent Van Gogh, Wassily Kandinsky and Edvard Munch, which begs the question: are those with synesthesia inclined to be more creative?

In examining studies pertaining to synesthesia and creativity, it appears many researchers are under the impression that there seems to be an association between the two. However, the way in which both creativity and synesthesia are tested ranges widely depending on the study. There are endless questionnaires and tasks to determine the type and extent of synesthetic capabilities, as well as creative aptitudes.

Synesthesia is an incredibly important topic to examine because it is neither completely understood, nor even widely known. Many live their lives as synesthetes without ever knowing because they believe the way they perceive stimuli and understand the world is typical. Human perception is much less limited than we believe, and in understanding not only the mechanisms behind synesthesia, but also the benefits to those who have the condition, we can further understand the human mind. Many believe that those with synesthesia have enhanced human

perception, and may even live richer, more colorful lives. Studying synesthesia can help to unlock these ideas and broaden our understanding of human perception.

### Art History: A Case Study

Synesthesia can often be seen in famous artists such as Vincent Van Gogh, Wassily Kandinsky and Edvard Munch, and using an art historical lens, it is evident their synesthetic conditions influenced their creativity and perception of art.

Beginning with Van Gogh, early in life he struggled with his piano lessons as he kept trying to find correspondence between piano notes and tones and colors (Campen, 1999). In a letter to his brother Theo, Van Gogh described how when an artist has shaky hands when drawing, it sounds like a violin (Taggart, 2019). Based on these anecdotes, and other similar

stories of Van Gogh, art historians believe that he had chromesthesia, which is the association of colors and sounds (Taggart, 2019). In Van Gogh's famous 1889 painting, *Starry Night*, he created a stylized landscape of the view out his asylum window at Saint-Rémy-de-Provence



(Sheets, 2017). The swirls in the sky made by individual brushstrokes of color are almost reminiscent of music notes. He did not simply paint what he saw in real life, he revised the landscape, adding in a village and other details (Sheets, 2017). The sharp contrast between the deep blues and bright yellows creates light in the painting, as well as drama and emotion. It feels as if the painting is moving and swirling around, though it is completely still. Art historians

greatly attribute his creativity and post-impressionism artistic stylization to his synesthetic capabilities.

Wassily Kandinsky, a Russian painter, was another artist who likely had chromesthesia. Kandinsky was part of the Blue Rider movement, a subcategory of German Expressionism (Sheets, 2017). With this movement, it was believed that true abstraction was the best way to conceive of and appreciate the natural world (Sheets, 2017). This abstraction was found through automatism, or allowing the physical to take over the mental, and keeping the mind out of art (Sheets, 2017). In his 1912 painting *Improvisation 28*, he utilized vibrant colors and abstract figures to evoke sensation. Kandinsky was famous for having composers play music while he



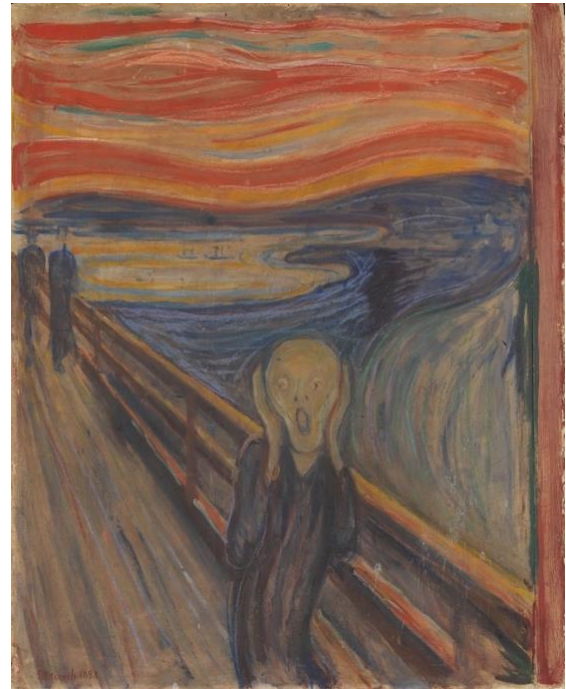
Painted, and he allowed himself to paint how the music sounded, in a synesthetic fashion. This is why many of his paintings were actually named after music movements such as this one. He utilized nonunified sound and musical compositions to create what is

considered one of the first truly abstract artworks. However, it is debatable if true abstraction was achieved as some figures and shapes can be seen within. On the top left there is a mountain peak, and a possible flood of water, and on the top right is a hill with city buildings atop. On the right there also appears to be figures kissing, and the bottom middle an eye with eyelashes can be identified. Art historians have argued that the left side of the painting represents the apocalypse, while the right represents salvation (Sheets, 2017). However, with the intent of the painting as

true abstraction, these interpretations are just conjecture. In viewing this painting in person, one can see the brushstrokes and feel the music that inspired Kandinsky to create this masterpiece.

The last artist to mention that shows many signs of synesthesia is Norwegian painter Edvard Munch. This painting created in 1893, *The Scream*, is part of an autobiographical series entitled *The Frieze of Life* (Sheets, 2017). This series attempted to capture non-visual sensations such as sound and emotion within paintings. Munch

was also thought to have had chromesthesia, and this painting is the visual depiction of, as the title suggests, a scream. The man in the center stands alone in shock, and his curving body blends with the twisting river that flows directly into the bright orange sky, lost in the pure emotion. The color palette of striking oranges creates the sensation of fear and nausea, while the deep blue hues elicit feelings of anxiety. The entire scene appears to



tremor and shake along with the central figure, who is thought to be Munch himself (Sheets, 2017). The two dark figures in the back, supposedly his friends, are rigid and straight, and mirror the stiffness of the bridge they stand on, anchoring themselves to reality. In looking at this image, one can almost hear the earth-shattering scream, and feel the anxiety and fear coursing through the painting.

While synesthesia is not limited to only chromesthesia and the types of synesthesia range widely, each of these artists provide visual insight into how synesthesia can present and the way in which it influences their perception of the world.



## **PART I: LITERATURE REVIEW**

### **Methods**

#### **Literature Search**

A literature search was completed using relevant databases (PubMed, NCBI, Wiley Online Library) utilizing the search terms synesthesia, synesthesia and creativity, synesthesia and artists, and other various search terms that were then followed upstream for useful references. Specific studies pertaining to synesthesia and creativity are outlined citing a variety of research studies. The research papers and studies utilized for this paper comprise a variety of different methods both in terms of how they empirically determine levels of creativity and synesthesia.

#### **Synesthesia Tests**

Pertaining to synesthesia, one common way of determining the synesthetic experiences of a participant is via a questionnaire. One common questionnaire begins with a detailed definition of synesthesia, emphasizing that these experiences are immediate and spontaneous, and not resulting from a conscious effort to pair or associate stimuli (Domino, 1989). Next, the participant is given five scenarios that indicate synesthesia and four that contradict and are asked to rate them on a scale of 1 to 5 of how often they occur in that particular participant (Domino, 1989). An experience that indicates synesthesia may be if music elicits colors, or if smells can be paired with particular sounds (Domino, 1989). However, an example of a scenario that does not align with synesthesia is when an old song brings back emotions or memories to that person (Domino, 1989). In this questionnaire, the participant is also asked about drug use, extreme fatigue, childhood memories of synesthetic experiences, or if any family members exhibit signs of synesthesia, in an attempt to gather as much information as possible about the participant

(Domino, 1989). It was important to researchers that they control for potentially misleading responses and could rule out inconsistent answers, experiences lacking spontaneity, or occurrences arising from drug use or extreme fatigue.

Another research study utilized computerized grapheme-color consistency tests to determine synesthetic abilities (Meier & Rothen, 2010). This involved a total of 36 graphemes, letters A-Z and numbers 0-9 and the participants were asked to associate these with 13 basic colors (Meier & Rothen, 2010). The participants were then tested at a later point and to find a consistency score, with the idea that synesthetes would have higher consistency than the control group (Meier & Rothen, 2010).

A different study utilized this idea of consistency in a rather similar way. The participants were given various days, months, letters, numerals and nouns, and were asked to associate a color with each (Ward et al., 2008). At least two months after the original test, most subjects averaging nine months after, the participants were given the same test again to evaluate the consistency (Ward et al., 2008).

## **Creativity Tests**

Creativity tests saw the most diversity in these studies, as no one study used the same methods. One study utilized Mednick's Remote Associates Test, a measure of creativity that examined the participants' association between colors and pure tones which may determine cross-sensory linkages (Sitton & Pierce, 2004). The same study also examined the participants' ability to create puns, as this requires uncommon word associations to create humor, and the researchers believed this demonstrated creative ability dependent on free associative thinking and spontaneity in responses (Sitton & Pierce, 2004).



In the Ward et al. study, researchers utilized two different tests to determine creativity (2008). The first was an Alternate Uses Test (ALT) where the participants were given six objects and were asked to find six alternate uses for each, taking no more than eight minutes to make these associations (Ward et al., 2008). The responses were then ranked by a panel for how creative or unique they were compared to average responses (Ward et al., 2008). This study also used the Remote Associations Test (RAT) which gave the participants sets of three words and they were asked to find a fourth word that could be associated with each word in the group (Ward et al., 2008). For example, the three-word group ‘snow-base-dance’ was given, and a standard answer would be ‘ball’ as it associated to each of these words individually (Ward et al., 2008). In addition to these creativity measures, the researchers also inquired about the participants’ engagement in the production of visual art, time spent playing instruments and how much time they devote to looking at visual art in a questionnaire to add supplementary information (Ward et al., 2008).

In another study that utilized multiple creativity tests to ensure the results were consistent, they chose five differing examinations (Domino, 1989). The first was the Adjective Check List, or ACL, which contained 300 adjectives and were scored on the 59 item Creativity Scale (Domino, 1989). The next was the Barron-Welsh Revised Art Scale which examines how the subject likes or dislikes 86 designs, which is meant to empirically separate artists from non-artists (Domino, 1989). After was the Obscure Figures Test (OFT) which gave 40 “doodles” and asked the participant what they represent, then evaluating these responses by how innovative they were (Domino, 1989). Then was the Similes Test which had participants think of three different endings to incomplete similes (such as: this pencil is sharp as a...) and the response is

scored on a five-point scale for originality. Finally, the Quick Word Vocabulary Test measured verbal intelligence with multiple choice definitional questions of terms (Domino, 1989).

### **Results/Discussion**

Despite the wide-ranging methods used to classify synesthetic abilities or creativity, the results of each of these studies supported the hypothesis that synesthesia enhances creative abilities. In Domino's 1989 study, it was found that of the 358 fine arts students surveyed, 23% reported to have synesthetic experiences (1989). Of the 61 synesthetes and 61 control participants, those with synesthesia scored significantly higher in four of the tests performed, with the exception of the Quick Word Vocabulary test (Domino, 1989). This study demonstrated a strong correlation between synesthesia and creativity, and that those with synesthesia may be more likely to pursue the fine arts (Domino, 1989). This study is important because the groups were not statistically different in terms of age, major, year, or verbal intelligence, but the presence or absence of synesthesia determined the creative outcomes (Domino, 1989).

In the Sitton & Pierce study, it was found that the unusual sensory associations relating to synesthesia might enhance verbal creativity in the form of puns (2004). The puns created by the synesthetes showed to be more spontaneous demonstrating nonanalytical thinking (Sitton & Pierce, 2004).

With the Meier & Rothen study, of the 99 Zurich art students and 96 control visitors that participated in the grapheme-color consistency test, the art students demonstrated consistency scores that were more likely to be in the determined synesthetic range than the control (2010). These results determined that synesthesia is more prevalent in art students than in the general population (Meier & Rothen, 2010). It was mentioned by the researchers that these students

likely chose to attend art school because synesthesia opened a richer world of perception which allowed them to refine their art skills more than the average person (Meier & Rothen, 2010).

Finally, in the Ward et al. study, between those assumed to be synesthetic due to high scores on the color-association reliability test and those who scored low and were treated as the control, those with synesthesia had more creative answers in the Remote Associations Test (2008). Interestingly, the Alternate Uses Test results were not found to be significantly different between the two groups (Ward et al., 2008). The researchers believe it may be because the RAT test is more sensitive than the ALT test, and thus more conclusive, however, this was just a theory to explain the diversion from their predictions (Ward et al., 2008). In regard to the questionnaire pertaining to artistic activities the participants engaged in, those with synesthesia were found to create or interact with visual arts or play musical instruments more often than the control group (Ward et al., 2008). The conclusion was similar to the Meier & Rothen 2010 study because Ward et al. determined those with synesthesia may be more motivated to engage in the arts, making them more commonly found in these areas.

There were a few potential problems that were noted through examining these studies. The first is that many of the tests for synesthesia were from self-report questionnaires, and these were sometimes not graded for accuracy. In Domino's study, he outlined the process of how the panel determined the reliability of the responses to pare down the study to only include participants they were positive had synesthetic abilities (1989). However, many studies did not engage in this action, or did not include it in their study's methods. This could easily impact the results if participants were included without valid claims of synesthesia. Synesthesia is difficult to classify, and not something that can simply be 'diagnosed' by a doctor, which makes it challenging to determine if someone has it based solely on their responses to a questionnaire.

Another issue was that many studies were not inclusive of all types of synesthesia, or only looked for a particular type. For example, the Meier & Rothen study only examined those with grapheme-color synesthesia for creative abilities, which is not inclusive of other types. While it is difficult to test participants with a range of synesthetic capabilities, it makes the data more generalizable to all types of synesthesia.

Overall, while there seem to be a variety of studies and sources that support the hypothesis that synesthesia allows for greater creative abilities, there is still much research to be done in this area. In discussing synesthesia on a larger, more public scale, others may discover they can resonate with being synesthetic where they may not have realized their capabilities before. Synesthesia is not a commonly known condition, so many live their lives without ever realizing their experiences are unique. In addition, by increasing the number of synesthetic participants in studies, as well as varying the types of creativity tests conducted, this field could be expanded and more could be learned about synesthesia, creativity and human perception.

## **PART II: THINK ALOUD TASK ANALYSIS**

### **Methods**

As mentioned previously, there are a variety of different tasks in which researchers can study and categorize creativity. Within the Neuroscience of Emotion and Thought (NET) Lab (PI = Dr. Jessica Andrews-Hanna), researchers Quentin Raffaelli and colleagues sought to characterize rumination, and subsequently creativity, in a way that examined the participants' inner workings. In the Think Aloud Task, participants (n = 81; mean age = 19.52, sd = 2.24; female = 46, male = 32, non-binary = 1, NA = 2) were instructed to voice their thoughts aloud

for ten minutes. The goal was to grasp the participants' 'inner voice' and examine idle thoughts and the participants' thought processes.

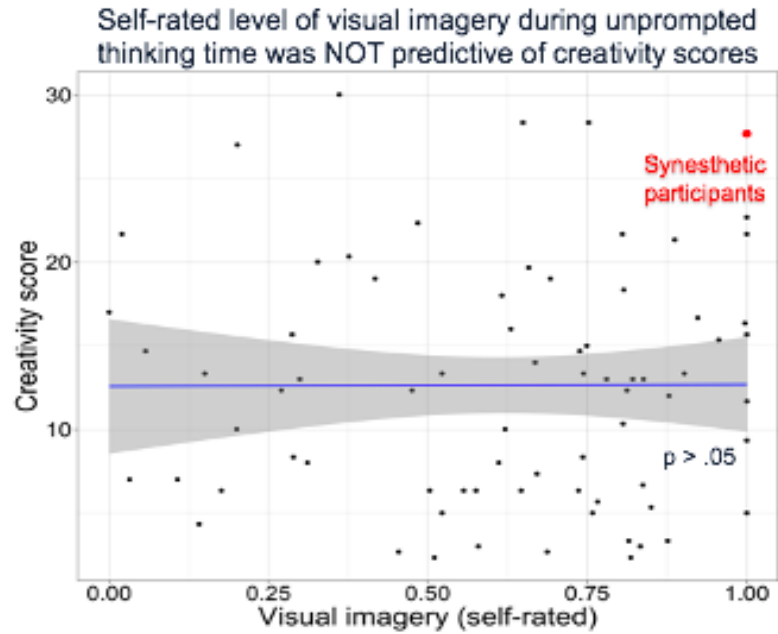
Ideally, the Think Aloud Task would have been conducted with a group of synesthetes to examine their visual imagery and creativity; however, with the barriers of COVID-19, an existing data set that utilized a random sample of participants was analyzed. This is still a worthwhile endeavor because examining mental imagery, in any capacity, gives insight into the thought processes of the creative mind. Those with synesthesia often have visual precepts, so the goal was to examine if the connection between mental imagery and creativity holds true for the general population. Though the participants were thought to have been neurotypical, one participant in the study disclosed they are synesthetic. At this point, not only was the study examining how average people perform in the think aloud, but this synesthetic participant can be used as a case study and point of comparison to the other participants.

Within the Think Aloud Task, there were two different variations. In one task, participants were instructed to voice their thoughts aloud for ten minutes with no prompt as to what to think about. Following the task, participants self-rated on a sliding scale (0: not at all to 1: extremely) "to what extent were [their] thoughts accompanied by visual imagery (i.e., images in your mind's eye)?" In the second task, participants were again instructed to voice their thoughts aloud for ten minutes, but this time in response to a creativity prompt. Participants were to answer the following prompt: "How would you make money with 100 rubber bands?" This prompt was adapted from the Torrance Tests of Creative Thinking (1966) as a form of the unusual uses task. Again, following this task participants rated "to what extent were [their] thoughts accompanied by visual imagery?"

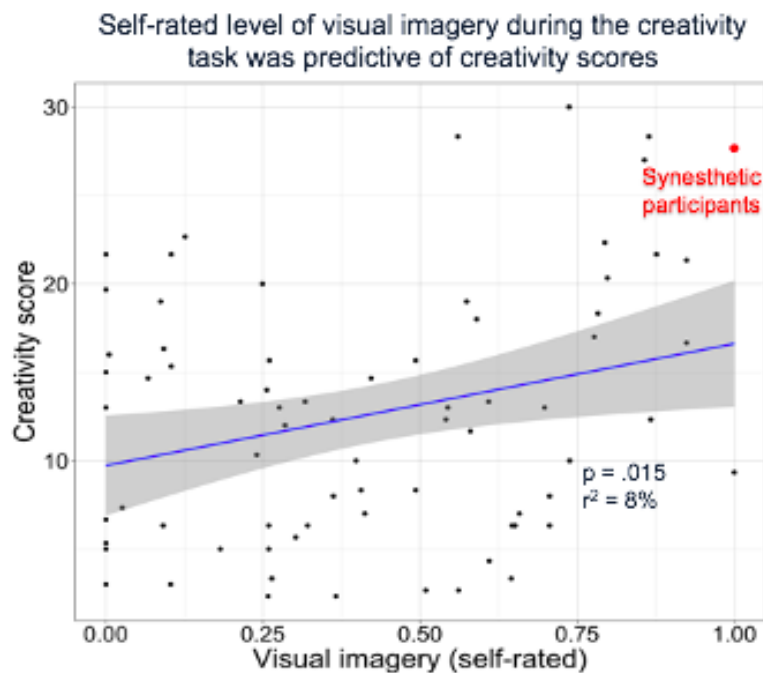
Using the participants' audio transcripts from the two tasks, three independent raters isolated each idea and rated them for originality. The raters displayed excellent interrater reliability (Cronbach  $\alpha = .92$ , CI.95 [.89 ; .95]). The participants' creativity scores were assessed by adding up the originality scores of all their ideas.

## **Results and Discussion**

Of all the retrospective data in the Think Aloud Task, it was crucial to examine imagery and fluency, or the overall creativity score. Our first research question examined if creative individuals are more likely to think with high levels of visual imagery. In particular, we examined whether this relationship existed when individuals were prompted to think creatively, as well as when participants engaged in spontaneous thoughts in general. Our second research question observed anecdotally if the self-disclosed synesthetic participant would fit the expected pattern of thinking with a high level of visual imagery across both spontaneous and creative thinking conditions and be more creative than average participants. With some forms of synesthesia, various sensory experiences can create heightened visual imagery, so this was important to observe.



**Figure 1.** This figure represents the imagery scores in the unprompted Think Aloud Task as related to participants' creativity scores. The x-axis denotes the participants' self-reported imagery scores during this task, and the y-axis represents the participants' overall creativity scores.





**Figure 2.** This figure represents the imagery scores in the Creativity Think Aloud Task as related to participants' creativity scores. The x-axis denotes the participants' self-reported imagery scores during this task, and the y-axis represents the participants' overall creativity scores.

These data from the unprompted Think Aloud Task, do not support the relationship that visual imagery is predictive of the participants' creativity scores in regard to spontaneous thought. The graph displays a flat line with limited correlation, and the P-value was greater than 0.05. However, these data from the Creativity Think Aloud Task support the hypothesis that imagery and creativity are positively correlated when participants were prompted to think creatively. The P-value was equal to 0.015, and it was found that visual imagery was in fact predictive of the participants' creativity scores

As stated before, during the Think Aloud Task, it was revealed that Subject ID10 is synesthetic. Subject ID10's self-rated visual imagery score in both the unprompted and creativity tasks was the highest possible score, far above the average of 0.60 (SD = 0.28) for the unprompted and 0.42 (SD = 0.30) for the creativity tasks. As for overall creativity, Subject ID10's creativity score was 27.67 compared to the mean of 13.11. Subject ID10's creativity score was among the top scores, and close to 2SD above the mean. In their audio transcript, Subject ID10 mentioned songs sounding like certain colors and described how they personally related sounds and colors. During the task, they also mentioned being a painter, supporting the data in the Meier & Rothen study that synesthesia is common in those involved in visual arts (2010). Overall, while these data involving Subject ID10 cannot be generalized to everyone with synesthesia, it gives insight as to how imagery and creativity in synesthetes may compare to the general population.

## **Conclusion**

Based on the research conducted over a variety of studies, there is no singular correct method to study synesthesia and creativity. With classifying synesthesia and testing the participants' abilities, the questionnaires either seek to determine the type of synesthetic associations the person has, or it tests to see if these associations are stable over time. In regard to creativity, these methods differ widely from color and tone associations, alternate uses for objects, word associations, artistic opinions, similes and even puns. With the NET Lab's Think Aloud Task, this was another method for quantifying creativity and mental imagery.

The overarching results of these tests is that because synesthesia impacts the interconnectedness of sensory pathways, synesthetic participants may be more creative than their neurotypical counterparts and may have increased abilities to create mental images. In regard to Art History, an argument can be made that artists such as Van Gogh, Munch and Kandinsky were heavily influenced by their synesthesia to create art and visual representations of their personal perceptions.

While not directly tested in these studies, it has been found that synesthesia can also allow for better sensory memory with enhanced sensory processing and protection of memories over time due to improved retrieval cues (Meier & Rothen, 2013). There are many potential benefits to synesthesia and solidifying our understanding of this unique topic could broaden how we view our world. Just as other animals do not experience the world the same as humans due to variations in their senses, all humans do not share the same experiences either. Those with synesthesia have fascinating views of the world based upon the way they perceive stimuli, and how their senses display interconnectedness. Studying the human mind should not be limited to understanding mental illness or disease, but it should also examine the beautiful things our minds

can do to help us see the world differently. By studying the causes, experiences, and even potential benefits to synesthesia, those who live richer, more colorful lives could help to unlock the key to understanding human perception.

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