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From the Editor's Desk

Spring is in the air and so is the latest edition of JPI. We hope this issue finds you doing well and furiously working to finalize your presentations for your upcoming conferences. To all student authors, please remember that much of the research that you read in this journal was first presented at local, regional, and national conferences. In fact, each year at this time we attend multiple conference on the look out for quality undergraduate research to support and encourage for submission to the journal. Whether it is your own research or that of a colleagues remember to close the research loop by disseminating your work through publication. Therefore once your done presenting for the year, please begin thinking about turning that presentation into a paper and submitting it to JPI.

Additionally, this is a special year in the US as election season is in full force. No matter which side of aisle you may support, this is an exciting time in our nation's history as well as a great opportunity for research! We hope to see research based on this election cycle in our upcoming issues of JPI under our special section for Current Events.

As is our tradition, we want to draw your attention to several of the unique features of JPI,. The first feature is that of The Elizabeth A. Dahl, Ph.D., Award for Excellence in Undergraduate Research. This award recognizes one article which is deemed to distinguish itself in undergraduate research in each issue. The award was created to celebrate the distinguished contributions of Dr. Dahl, who for 25 years as faculty member and chair of the Psychology Department at Creighton University, challenged, guided, and supported numerous undergraduate students in the design and execution of research, and the scholarly communication of results.

Furthermore, we want to remind all student that in

addition to traditional research, JPI also publishes quality literature reviews, dramatic analyses. and article on controversial issues.

Congratulations to all on a productive academic year . Everyone enjoy the summer and we will see you on the conference circuit!

Best regards,

Jenn Bonds-Raacke and John Raacke
Managing Editors

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Cover:

Logo: The creation of the graphic for the logo came about by thinking of how ideas are formed and what the process would look like if we could see into our brains. The sphere represents the brain, and the grey matter inside consists of all the thoughts in various stages of development. And finally, the white spotlight is one idea that formed into a reality to voice. The entire logo is an example of creation in the earliest stages.

Cathy Solarana, Graphic Designer

Cover Design: The overall design was influenced by many aspects of psychology. Much of the inspiration was developed through the use of the iconic symbol for psychology as well as the beauty of psychology in its own right.

Brittney Funk, Graphic Designer

The Role of Practice Testing and Presentation Style on Undergraduate Students' Retention of Information

Lindsey N. Mooney, Tammy L. Sonnentag & Cynthia L. Dulaney *
Xavier University

Abstract—Previous research on the testing effect has demonstrated that practice testing, whether open or closed book, is similarly effective in promoting long-term retention of information over non-testing (Agarwal, Karpicke, Kang, Roediger, & McDermott, 2008). Furthermore, the way in which information is presented (e.g., text vs. video) influences information retention (Merkt, Weigand, Heier, & Schwan, 2011). The current study extends previous research by examining the independent and interactive role of practice testing (i.e., open-book, closed-book, or no test) and presentation style (i.e., text or video) on undergraduate students' retention of information. A total of 149 students learned new information through video or text mediums and then completed an open-book practice test, closed-book practice test, or did not complete a practice test (control). Following a distractor task, participants completed a test of knowledge retention. The text medium and an open-book practice test both (independently) promoted greater retention of information.

Keywords: testing effect, learning, knowledge retention

With the exception of the past two decades, textbooks have served as the primary form of educational aid. However, with the emergence of the digital age, pictures, videos, and audio clips are increasingly accompanying conventional textbooks (Issa, Cox, & Killingsworth, 1999), and less conventional instructional tools such as websites and interactive games are becoming commonplace. Educators who employ the less conventional instructional tools question whether the tools contribute to increasing students' retention of information over conventional texts. Recent research suggests learning from less conventional tools (e.g., interactive videos) efficiently aids the learning process (Merkt, Weigand, Heier, & Schwan, 2011), but this learning may depend on the learners' expectancies concerning how their knowledge will be tested (i.e., open-book or closed-book testing; Agarwal, Karpicke, Kang, Roediger, & McDermott, 2008; Agarwal & Roediger, 2011). The purpose of the current study was to examine whether presentation style (i.e., text or video)

independently or in combination with practice testing (i.e., open-book, closed-book, or no test) promotes retention of information among university students.

The "testing phenomenon" (Glover, 1989, p. 392), also known as the "testing effect" (Agarwal & Roediger, 2011, p. 836), states the process of retrieving and applying knowledge through repeated testing opportunities positively impacts long-term retention of information (Glover, 1989). In fact, research has demonstrated knowledge retention is contingent on the amount of mental processing dedicated to particular information, with the greater number of "retrieval events" (p. 392) associated with greater final knowledge retention. In an examination of the testing effect, Glover examined individuals' retention of trivial facts or diagrams while manipulating the number of practice tests (i.e., no practice test, one practice test, more than one practice test) and type of recall (i.e., free-recall, cued-recall). Results revealed, for both free-recall and cued-recall, participants given

*Tammy L. Sonnentag & Cynthia Dulaney served as Faculty Sponsors.

one or more practice tests outperformed participants given no practice test. These findings support the notion that repeated opportunities to retrieve information increases individuals' retention of information.

Karpicke and Roediger (2007) found additional support for the testing effect when examining the effectiveness of study-testing patterns on students' retention of word lists. Specifically, Karpicke and Roediger randomly assigned participants to one of three study-test pattern conditions: alternating study sessions with practice tests (STST), three consecutive study sessions followed by one practice test (SSST), and one study session followed by three consecutive practice tests (STTT). A final test of retention, for all groups, was administered one week following the last practice test. Karpicke and Roediger predicted repeated practice tests would promote greater knowledge retention on the final test of knowledge. Results were consistent with the prediction; the repeated practice test conditions enhanced students' retention relative to repeated studying, with alternating the study and testing trials producing the greatest retention. These findings suggest repeated testing is an effective strategy to promote learning.

Closed- and open-book testing are two common educational practices used to assess students' learning. During closed-book testing, students recall or retrieve information without the aid of notes, textbooks, or electronic resources. In contrast, during open-book testing, students are allowed to consult their notes, textbook, or electronic resources. Research on the effectiveness of open- and closed-book testing is beginning to receive empirical attention. For example, Agarwal et al. (Study 1, 2008) examined whether open- or closed-book testing differentially effects retention of information. Specifically, participants were randomly assigned to study prose passages and then re-study or take an (initial) open- or closed-book test. One week after exposure to the prose passages, participants completed a short answer final test assessing their retention of the information. The results of the initial test revealed the open-book testing condition led to better performance than the closed-book testing condition, but this effect did not last, with both

open- and closed-book testing conditions equally promoting learning (relative to the re-studying control condition) on the final test. Therefore, the testing effect emerges for both open- and closed-book tests.

Although open- and closed-book tests may be equally effective in promoting long-term retention of information, students' expectancies concerning open- and closed-books tests (e.g., difficulty) may affect their learning. Examining the role of students' expectancies on the testing effect using open- and closed-book tests, Agarwal and Roediger (2011) asked participants to read passages, derived from the Graduate Record Exam, where they were told to expect no test, an open-book test, or a closed-book test. Results revealed participants spent less time studying and learned less when expecting an open-book test (compared to a closed-book test). However, both open- and closed-book testing conditions led to better performance than the no test (study only) condition. Overall, it seems that students' expectancies regarding the type of testing influence their learning.

In addition to traditional classroom assessment activities (i.e., tests), many students engage in some kind of content immersive activity in order to further their grasp of course concepts. Often this learning is achieved through the viewing of informational videos. In fact, researchers (e.g., Issa et al., 1999) have reported self-paced multimedia learning has a positive impact on high school and college students' learning, with retention being 21-28% better when using self-paced multimedia resources relative to traditional classroom lecture. Thus, the way in which information is presented also influences individuals' learning.

Merkt et al. (2011) compared students' retention of educational information about the political and economic situation in Germany after World War II across three types of presentation style: an enhanced video, a common video, and a content-equivalent illustrated textbook. The enhanced video contained "micro-level as well as macro-level activities" (p. 692), which included a start/stop button, a timeline navigation tool, a table of contents, and an index of key terms. The common video contained only micro-level

activities, “analogous to the features of a regular VHS tape, with a start/stop-, and a forward and a rewind button” (p. 692). The illustrated textbook served as a control condition and was a verbatim transcription of the video’s audio with accompanying screen shots. Merkt and colleagues hypothesized participants viewing the enhanced video would outperform participants in the common video group, and albeit somewhat surprisingly, retention for the illustrated textbook would be equivalent to that of the enhanced video (because enhanced video and text both afford micro and macro level features). Secondary school students from Germany were randomly assigned to one of the three presentation style conditions. Knowledge acquisition was assessed through the identification of facts, derived from the informational content, on an essay test. Results revealed the print medium was as effective as both video conditions in promoting retention; unexpectedly, the common video outperformed the enhanced video. These results suggest that, contrary to what students may expect, textbook reading is an effective tool, at least equally as effective as videos, for promoting retention of information.

Although text appears to be an effective medium to promote learning, it is possible some educational content may be easier to learn through print. Consequently, in a study examining memory for less traditional educational content (i.e., violent news stories presented in the media), college students were exposed to stories in either audiovisual, audio, or print mediums. Subsequently, participants completed a 20-item questionnaire assessing their memory for the stories. Results revealed a significant difference among all three mediums, with the print medium yielding the greatest recall and the audiovisual medium yielding the worst recall (Furnham & Gunter, 1987). Thus, text appears to be a reliable medium for promoting the learning of even less traditional education information as well.

Current Study

The present study examined the independent and interactive role of practice testing (i.e., open-book practice test, closed-book practice test, or no practice test) and presentation style (i.e.,

text or video) on individuals’ retention of information. Consistent with the research by Merkt et al. (2011), as well as Furnham and Gunter (1987), it was predicted that participants using a traditional text to learn novel content would outperform participants who use videos on a test of retention. Furthermore, consistent with the research by Agarwal and Roediger (2011), it was predicted that, on a final test of knowledge retention, participants informed of and given a closed-book practice test would outperform peers informed of and given an open-book practice test. Lastly, as an extension of previous research, the current study examined the combination of presentation style and practice testing on students’ retention of information, where the closed-book testing of text content was expected to yield the best overall retention of information compared to any other presentation-testing condition.

Method

Participants

A sample of 149 undergraduate students (51 male, 97 female, 1 preferred not to respond) from a small, Catholic university participated in exchange for course credit. The majority of students were advanced standing (third or fourth year of study; 60%), Caucasian (81%), and female (65%). Students from all three colleges at the university were represented in the study (53.3% College of Professional Sciences, 25.5% Arts and Sciences, 19.6% College of Business, 1.6% Undecided). Participant age ranged from 18 to 29 years old ($M = 20.18$, $SD = 1.38$).

Materials

Video or text presentation style. To assess the effectiveness of video- versus text-based mediums in promoting learning, two videos totaling 7:26 mins were obtained via YouTube, detailing the neurological phenomenon of synesthesia. A text version of the videos (see Appendix A) was created by precisely transcribing the video’s content and including accompanying still-framed photographs from the videos.

Practice and final tests. Parallel 59-item variable-style practice and final tests of knowledge about synesthesia were created for this study (see Appendix B for final test). Items on the practice

and final tests were derived by the first author by identifying the factual content described in the videos about the neurological phenomenon of synesthesia. The second author reviewed the videos to verify the factual content presented on the practice and final tests. Correct responses on the final test of knowledge were summed, after hand scoring participants' tests with higher scores reflecting better retention of information. Scores on the practice and final tests were significantly correlated ($r = .78, p < .001$).

Procedure

The study was conducted in small groups of 8 to 15 students as a 2 x 3 between-subjects factorial design, in which participants were randomly assigned to learn about synesthesia via a video or text medium and participate in an open-book practice test, a closed-book practice test, or no practice test.

University IRB approval was obtained prior to conducting the present study. Upon beginning the study, participants completed an informed consent document and responded to demographic questions assessing their age, gender, race, academic year, and previous exposure to information about synesthesia (see Appendix C). After describing the purpose of the study, but prior to viewing the video- or text-based content, one third of the participants were informed to anticipate an open-book practice test, another third of participants were informed to anticipate a closed-book practice test, and the final third of participants were not informed of (nor provided) a practice test. As an incentive for active participation in the study, participants were also told that scoring over 60% on a final comprehension test would qualify them for entry into a drawing for a \$30 gift card (all participants were, in fact, entered into the drawing regardless of performance on the final test). After this information was provided, participants were presented with the brief, factual content concerning the neurological phenomenon of synesthesia in the form of either video or text. Participants were instructed to study the content at their own pace and were then invited to complete an open-book practice test, a closed-book practice test, or were not invited to complete a

practice test. Although the time taken by each participant to review the material was not recorded, the first author observed participants took more time to review the material in the open-book compared to the closed-book practice-test conditions. Participants in the closed-book practice test condition were not permitted to refer back to their content during the test, whereas, in contrast, participants in the open-book practice test condition were allowed to actively refer to the content to confirm and/or search for correct answers. Subsequently, all participants were exposed to a distractor task, involving participating in an unrelated study and then asked to complete the final, self-paced, closed-book test measuring their retention of information about synesthesia. At the end of the study, participants were thanked and debriefed.

Results

Participants' previous knowledge of synesthesia was unrelated to their practice ($r = .10, p > .05$) and final ($r = .12, p > .05$) test scores and, therefore, was not controlled for in subsequent analyses. To test the prediction that closed-book testing of information presented through a text medium would yield the best overall retention of information compared to the other presentation-testing conditions, a 2 (presentation style: video, text) x 3 (practice test: open, closed, no) between-subjects analysis of variance (ANOVA) was conducted on the number of correct items on the final test of knowledge retention. The interaction between practice test and presentation style was not significant, $F(2, 143) = 0.73, p > .05, \eta_p^2 = .10$. However, the main effect of presentation style was significant, $F(1, 143) = 12.76, p < .001, \eta_p^2 = .08$, revealing individuals learning through text ($M = 12.21, SD = 1.79$) outperformed individuals learning through video ($M = 11.17, SD = 1.79$) on the final test of knowledge retention. Furthermore, the main effect of practice test was significant, $F(2, 143) = 3.81, p < .05, \eta_p^2 = .05$. Follow-up post-hoc tests, using a Bonferroni correction, revealed participants given an open-book practice test ($M = 12.22, SD = 1.88$) outperformed individuals who did not receive a practice test ($M = 11.28, SD = 1.71$) on the final test of knowledge retention. No differences emerged between open-book practice

($M = 12.22$, $SD = 1.88$) and closed-book practice ($M = 11.63$, $SD = 1.89$) tests or closed-book practice and no practice test ($M = 11.28$, $SD = 1.71$).

Discussion

Extending previous research on the factors influencing students' retention of information, the present study examined the independent and interactive role of practice testing (i.e., open-book, closed-book, or no test) and presentation style (i.e., text or video) on undergraduate students' retention of information. Results revealed learning information through text and participating in an open-book practice test both (independently) promoted greater retention of information. In general, the present findings yield valuable information about the ways educators can promote the retention of information among college students, as well as questions that provide important directions for future research on the topic.

The current investigation adds further support to prior research (see Furnham & Gunter, 1987; Sundar, Narayan, Obergon, & Uppal, 1998) demonstrating learning through text is superior to learning through video when attempting to recall facts mentioned in the mediums. This finding suggests the way in which information is presented plays a role in how well information is absorbed and retained. One possible reason for this difference is the cognitive effort expended in order to understand the content (see Mayer, Hegarty, Mayer, & Campbell, 2005). Sundar and colleagues (1998), as well as Furnham and Gunter (1987), contend print content (relative to video content) may innately contribute to greater retention, most likely due to the greater demand of mental energy the text medium requires. In the present study, participants may have actively engaged with the text content, interacting more meaningfully with the content in this medium, whereas participants may have passively received or reviewed the content in the video. However, an alternative explanation for this effect may be that video requires greater cognitive load than print, because the learner must hold the information in memory without the memory aid provided by print.

One of the primary purposes of the present study was to examine if participants who

anticipate and complete a closed-book practice test would outperform peers who anticipate and complete an open-book practice test. Contrary to prediction, completing an open-book practice test did not enhance performance on a final knowledge test relative to a closed-book practice test. The only significant difference to emerge for the role of practice testing on retention of information was that an open-book practice test promoted greater retention of information compared to no practice test. Although inconsistent with prediction, the result supports research by Agarwal et al. (2008), who found recall of learned facts was higher for an open-book initial (or first) test compared to no test or a closed-book initial test (however, this difference did not last for a final test, occurring one week after exposure to the information). Consequently, this finding suggests retention of information practiced with open-book tests may initially be more successful than retention of information practiced with closed-book tests. It is possible that because open-book tests rely less on drawing from long-term memory than closed-book tests, performance on open-book tests may be superior. In future studies, manipulating the number of open- and closed-book practice tests, as well as the time between practice and final tests, may reveal the most effective strategy for using practice tests to increase long-term retention of information.

Limitations and Future Directions

The present findings contribute to the understanding of the role of presentation style (i.e., text or video) and practice testing (i.e., open-book, closed-book, or no test) on undergraduate students' retention of information. The brief discussion presented next describes three important directions for future research on the topic.

Although utilizing a college student sample was a strength of the current study, individuals in this particular age group may be adept learners, as evidenced by their acceptance into a four-year university. However, because today's college students grew up in an educational system where media in the classroom was increasingly encouraged, the results of the current study may not generalize to other age groups. Additional

research should take a cross-sectional methodological approach to studying the role of presentation style (and practice tests) on individuals' long-term retention of information, as this research may reveal that the degree to which each generation has been immersed in technology may influence the effectiveness of learning through video versus text mediums.

Furthermore, although the current study found learning about the neurological phenomenon of synesthesia through text was more effective than learning through video, one possible explanation for this difference is the "interactivity" (Merkt et al., 2011, p. 687) of the mediums. Text, relative to video, allows for greater interaction between the reader and the content (see arguments by Merkt et al., 2011), as the reader can stop to reflect on difficult concepts, re-read an interesting passage, and/or backtrack to make connections between or among ideas. Consequently, the more interactive and engaging the medium, the more information processing that may occur and the better the long-term retention of the information (Furnham & Gunter, 1987; Merkt et al., 2011). With this idea in mind, future research should examine if the relationship between a medium's interactivity and learning is moderated by the amount of control learners exert over their information processing. For students who exert relatively high control over their information processing (i.e., enjoying thinking about difficult content), maybe text and video would equally promote content retention. Finally, with new interactive educational content being developed every day, the current study should be conducted in more naturalistic settings, testing students' memory for actual classroom content.

Finally, the finding that open-book practice tests contribute to greater retention of information compared to no practice tests provides a direction for future research. Specifically, future research could examine if the difficulty of a learning task (i.e., cognitive effort expended) influences the effectiveness of practice tests on retention of information. Such research may reveal that greater cognitive effort explains why practice tests are effective relative to no practice tests.

Conclusion

In sum, the present study demonstrates learning information through text and providing open-content practice tests both (independently) promote greater retention of information among college students. Despite the limitations of the present study, the findings have implications for educational settings, as educators can be assured that assigned text-based readings are beneficial to students' knowledge acquisition and retention. Furthermore, educators can be confident that open-book practice tests encourage learning relative to not providing a practice tests. Future research should investigate the long-term retention of information based on the varied presentation styles and practice opportunities that exist in higher education. Further, additional research is needed with regard to the effectiveness of closed-book practice tests to promote retention of information in order to evaluate its merit. Finally, the acquisition of knowledge in different academic areas, such as mathematics or history, may rely on different types of presentation methods. Therefore, continued research examining the importance of presentation style and practice testing for specific academic areas is needed.

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Appendix A

Text for Video 1: What color is Tuesday? Exploring synesthesia
<https://www.youtube.com/watch?v=rkRbebvoYql>

Imagine a world where you see letters and numbers in color even though they're printed in black, a world in which music or voices trigger a swirl of moving colored shapes, a world in which words and names fill your mouth with unusual flavors. "Jail" tastes like cold and hard bacon, while "Derek" tastes like earwax.



Welcome to synesthesia, the neurological phenomenon that couples two or more senses in 4% of the population. A synesthete might not only hear a voice, but also see it, taste it, or feel it as a physical touch. Sharing the same root with anesthesia which means no sensation, synesthesia means joined sensation. Having one type, such as colored hearing, gives you a 50% chance of having a second type, or third, or fourth. One in 90 among us experience graphemes, the written elements of language, like letters, numerals, and punctuation marks, as saturated with color. Some even have gender or personality. For Gail, 3 is athletic and sporty, 9 is a vain and elitist girl. By contrast, the sound units of language, or phonemes, trigger synesthetic tastes. For James, college tastes like sausage, as does message and similar words with the "-age" ending.



Synesthesia is a trait, like having blue eyes, rather than a disorder because there's nothing wrong. In fact, all the extra hooks endow synesthetes with superior memories. For example, a girl runs into someone she met long ago. She thinks, "She has a green name, D's are green: is it Debra, Dolores, Denise? Oh I remember! Her name is Denise!"

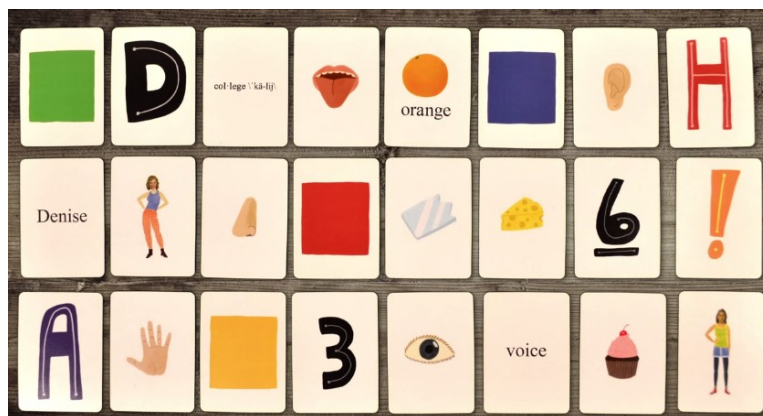
Once established in childhood, pairings remain fixed for life. Synesthetes inherit a biological propensity for hyper-connecting brain neurons, but then must be exposed to cultural artifacts, such as calendars, food

names, and alphabets. The amazing thing is that a single nucleotide change in the sequence of one's DNA alters perception.

In this way, synesthesia provides a path to understanding subjective differences, how two people can see the same thing differently. Sean for example, prefers blue tasting food, such as milk, oranges, and spinach. The gene heightens normally occurring connections between the taste area in his frontal lobe and the color area that is further back. But suppose in someone else that the gene acted in non-sensory areas. You would then have the ability to link seemingly unrelated things, which is the definition of a metaphor, seeing the similar in the dissimilar.

Not surprisingly, synesthesia is more common in artists who excel at making metaphors, like novelist Vladimir Nabokov, painter David Hockney, and composers Billy Joel and Lady Gaga. But why do the rest of us non-synesthetes understand metaphors like "sharp cheese" or "sweet person"?

It so happens that sight, sound, and movement already map to one another so closely, that even bad ventriloquists convince us that the dummy is talking. Movies, likewise, can convince us that the sound is coming from the actors' mouths rather than surrounding speakers. So, inwardly, we're all synesthetes, outwardly unaware of the perceptual couplings happening all the time. Cross-talk in the brain is the rule, not the exception. And that sounds like a sweet deal to me!



Text for Video 2: Hearing Colors, Seeing Sounds: Synesthesia
 (<https://www.youtube.com/watch?v=vEqmNX8uKIA>)



You might think you have to be on some psychoactive street drug to see music or taste the feeling of the wind in your hair. This is not the case! You could instead have synesthesia, a neurological condition in which two senses are perceived simultaneously. Synesthesia is Greek for “joined perception” and it can involve mixing any of our senses, sometimes even three or more of all of them at once though that is more rare.

Researchers have found that synesthesia is often inherited though members of a family will sometimes have different types. Scientists at Baylor University think that they’ve identified a region of the DNA on chromosome 16 as the culprit at least for the most common form called Colored Sequence Synesthesia. This is when people perceive letters, numbers, words, days of the week, or whatever else as being inherently colored. For example, like the letter A is red and the number 4 is brown.



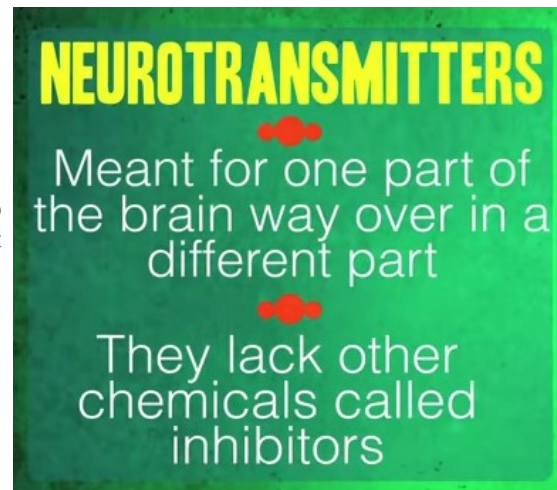
You might be thinking, well that person probably just had a red “A” magnet on their refrigerator when they were a kid so they think of “A”s as being red. But most studies suggest that there is something funny going on with the synesthete’s brain. Although there is no established way to diagnose synesthesia, true synesthetes have a few things in common. First, their mixed perception of senses is involuntary, it happens without them thinking about it. Second, their condition is experienced rather than imagined. If you ask what color is a triangle, a synesthete would see a color like yellow immediately and they wouldn’t have to think

about it before their brain made the association. Third, the sensory mix up of synesthesia is durable, meaning that the associations are always the same. Bacon cannot taste like Bach one day and Beethoven the next. Fourth, often the secondary perception of the thing will be more memorable than the primary one. So the synesthete always associates the name Dave with the color purple, they'll usually remember the purple first which tells them that the name is Dave. Finally, the fifth thing is the perceptions may be very emotional. Like, oh no, this Elton John song playing at TJ Max smells like gasoline, help!!

Now of course the question is: what are these people's brains up to? One idea is that it might be due to a defect in the neural structure. Scientists theorize that we're born with our senses sort of all tangled up and then over time our brains shut down the neural bridges between our senses so we experience them separately. Synesthetes might not be properly shutting down those bridges making their lives a little bit trippier than everyone else's.

Another theory suggests that synesthesia is caused by neurochemistry; our neurons communicate with each other through chemicals called neurotransmitters. It could be that synesthetes have neurotransmitters meant for one part of the brain way over in a different part or they could lack chemicals called inhibitors that help keep neurotransmitters in check. This would explain why a lot of synesthetes have different experiences when they're really tired or really hungry, or why these experiences happen to people on hallucinogenic drugs.

And of course, because our brains are complicated placed it could also be a combination of all of these things. For now, synesthesia is another one of those things that we don't completely understand about the delicious, amazing things that are our brains



Appendix B

1. Having one type of synesthesia _____ your chances of having a second type by ____.
 - a. Decreases; 40%
 - b. Decreases; 50%
 - c. Increases; 70%
 - d. Increases; 50%**
2. Individuals with Synesthesia are commonly skilled at creating:
 - a. Music
 - b. Metaphors**
 - c. Narratives
 - d. Chaos
3. Those who are experiencing synesthesia are actually:
 - a. Imagining a sensory pair up
 - b. Hallucinating
 - c. Suffering brain damage to the affected area
 - d. Experiencing the pairing of two or more senses**
4. Synesthesia is a:
 - a. Adaptation
 - b. Genetic Trait**
 - c. Disorder
 - d. Phenomenon
5. One in 90 among us experience graphemes and/or Colored Sequence Synesthesia. What do these types of synesthesia look like?
 - a. Nonverbal sounds accompany geometric shapes
 - b. Spoken language is associated with music
 - c. The written elements of language are unmistakably colored**
 - d. Specific textures are revealed to have distinct tastes
6. What is the most common form of synesthesia?
 - a. Hallucinations
 - b. Graphemes
 - c. Colored Sequence Synesthesia**
 - d. Phonemes
7. Circle the theorized explanations for synesthesia (all that apply):
 - i. When we are born our senses are of all tangled up. Over time our brains shut down the neural bridges between our senses so we experience them separately. Synesthetes do not properly shutting down those bridges.**
 - ii. Synesthetes have neurotransmitters meant for one part of the brain way over in a different part of the brain**
 - iii. Synesthetes lack chemicals called inhibitors that help keep neurotransmitters in check.**
8. Synesthetes involuntarily experience mixed perception
 - a. False
 - b. True**
9. Synesthesia means
 - a. No sensation
 - b. Restricted sensation
 - c. Joined sensation**
 - d. Abnormal sensation
10. What hallucinogenic substance can cause synesthesia?
 - a. Psilocybin mushrooms
 - b. LSD/Acid
 - c. Marijuana
 - d. None of the above**

11. Someone always associates the color green with the letter T and all names that begin with T. When remembering the name Theresa, what happens first?
 - a. They remember the name Theresa and immediately see green therefore making the connection concrete
 - b. What an individual remembers first is variable and dependent on the individual synesthete
 - c. They remember that the person's name is green and then determine that it must be a T name before concluding that it is Theresa**
 - d. They remember green first because the person appears green to them.
 12. The pairings formed by synesthetes are:
 - a. Terminal, meaning they have an expiration date
 - b. The same for all synesthetes
 - c. Fixed for life**
 - d. Susceptible to cultural change
 13. Synesthesia affects what percent of the population?
 - a. 44%
 - b. 4%**
 - c. .4%
 - d. .04%
 14. The gene that causes synesthesia _____.
 - a. severs the connections between the sensory sections of the brain and the information processing section of the brain
 - b. disrupts the hypothalamus and distorts all sensory input
 - c. heightens normally occurring connections between one area of the brain and a different sensory area of the brain**
 - d. couples different areas of the brain and makes them undistinguishable
 15. Unless a person has synesthesia, their sensory portions of the brain do not communicate.
 - a. False**
 - b. True
-

Note. Correct responses are bolded

Appendix C

This survey is intended to collect demographic information about individuals participating in this experiment. All responses are anonymous. Your participation and honesty are appreciated. Please circle or insert your responses to the items below.

1. Gender:
 - a. Male
 - b. Female
 - c. Prefer not to respond

2. Race/Ethnicity:
 - a. Asian
 - b. African-American or Black
 - c. Native American
 - d. Caucasian
 - e. Hispanic
 - f. Pacific Islander
 - g. Prefer not to respond

3. Age (in years): _____

4. Residential Status
 - a. Living off campus with Parents
 - b. Living on Campus
 - c. Living off campus without parents

5. Year in school:
 - a. First Year
 - b. Second Year
 - c. Third Year
 - d. Fourth Year
 - e. Fifth Year
 - f. Other

6. Major: _____

7. How much do you feel you know about Synesthesia (circle one)?
 - a. Very Much (5)
 - b. Much (4)
 - c. Some (3)
 - d. Little (2)
 - e. Very Little (1)
 - f. Nothing (0)

Why Do People Justify Choices They Had Not Actually Made?

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Abstract—In the choice blindness paradigm, participants select one of two stimuli they prefer, then examine the selected stimulus and describe their reasons for preferring it. However on some trials, the stimuli are switched so participants examine the stimulus they had rejected, and yet most participants are willing to describe why the rejected stimulus was the one they had selected. This implies participants fail to notice the switch because they are willing to justify a selection they did not actually make. One objection to choice blindness experiments is that participants may actually notice the switch, but just play along with the experimenter’s deception. In two experiments, we respond to this objection. We argue that when participants have a reason to load the stimuli into their short-term memory, they are likelier to have a memory trace that clashes with the switched stimulus. In Experiment 1, we hypothesized that images of foods were likelier to engage short-term memory than images of faces, and almost all participants in the foods condition noticed the switch, supporting our hypothesis. Although food images may engage short-term memory more than face images, a possible confound is that foods are more familiar than faces of unknown people. To address this confound, all participants in Experiment 2 viewed images of faces, but in one condition the switched faces were more distinct than the other condition. More participants noticed switches in the distinct faces condition than the similar faces condition. Taken together, these results suggest that choice blindness is the result of both attention and memory. .

Keywords: choice blindness, attention and memory, food images, familiar and unfamiliar faces

When asked to justify a past decision, do people recall the reasons for making the decision, or instead do they concoct a rationale on the fly? Although it seems much more plausible that people would always base their justifications on memory rather than building them from scratch, recent studies (Downs & Sobel, 2015; Johansson, Hall, Sikstrom, & Olsson, 2005) suggest the opposite is often true. In these studies, participants were asked to justify choices they had not actually made, so there could have been no memory of having made the choice, and yet participants were willing to describe their justifications. Participants could be said to be blind to their past choices, so Johansson et al. (2005) called this phenomenon “choice blindness” (p. 116).

In the original choice blindness study (Johansson et al., 2005), the experimenter presented pairs of images of female faces to

participants, then placed the images face-down on the tabletop and asked participants to point to the face they considered to be more attractive. The experimenter then slid the selected image face-down to participants who picked it up and described the reasons for having chosen that face. There was a trick to this task though. On some trials, the experimenter used a simple sleight of hand technique to get the rejected face into participants’ hands without them noticing the switch. As a result, participants were given the face they had judged to be *less* attractive, and asked why they had selected it as the *more* attractive face. Intriguingly, 74% of participants were willing to describe their justification, implying they hadn’t noticed the switch.

Downs and Sobel (2015) argued that in the typical choice blindness paradigm, participants are not really blind to their decisions, but instead fail

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to remember their choices. The failure to remember prior choices occurs because when simultaneously viewing two images participants have no incentive to load the images into their visual short term memory (VSTM). As a result, there is not likely to be a VSTM trace to clash with the switched image in the switch trials. To support this argument, we presented two images, simultaneously in one experimental condition and sequentially in another condition. Comparing one image with another that becomes visible only after the first image is no longer available requires participants to load the first image into their VSTM. Our hypothesis that participants would be more likely to have a memory trace in the sequential condition was supported by the fact that switches were noticed more often in the sequential condition than the simultaneous condition. It seems participants aren't blind to their choices, but instead they fail to remember their choices. Nevertheless, we replicated the most intriguing aspect of the choice blindness paradigm, insofar as most participants in both conditions were willing to describe their justifications in switch trials. This implies that when asked to justify previous choices, people create justifications when they are unable to remember the reasons.

Choice blindness has been shown to occur with other kinds of stimuli besides images of faces, including the taste of jam (Hall, Johansson, Tärning, Sikström, & Deutgen, 2010). Experimenters used a specially built jam jar with lids on both the top and bottom and a hidden divider between them. Participants tasted one jam and the experimenter casually flipped the jar over before setting it down so the other jam was on top. The participant would then taste the second jam and the experimenter would do the same flip with the second jar. Now the upper jar on the right held the jam that had been in the jar on the left side and vice versa. Participants pointed to their preferred jam, the experimenter opened the selected jar, gave participants another taste and asked them to describe why they had selected that jam. As with faces, a majority of participants conjured a reason for selecting the jam they had actually not selected. Similar findings occurred with touch (Steenfeldt-Kristensen & Thornton, 2013) and

with moral decisions as part of an opinion poll (Hall, Johansson, & Standberg, 2012).

Despite the fact that choice blindness has been shown to occur with vision, touch, and taste, all of the choice blindness results are vulnerable to the same objection: it seems implausible that a person could fail to remember a choice made just moments before. Alternatively, perhaps participants actually notice the switch, but are too polite to speak up about it. Participants might feel social pressure to play along with the experimenter, who acts like nothing unusual is happening in switch trials. In two experiments, we respond to this objection. Extending on the arguments in Downs and Sobel (2015), we believe that when comparing two simultaneously visible images or two jams that are tasted at about the same time, participants are making an aesthetic judgment without any need to involve memory. Also, the fact that more participants in Downs and Sobel noticed the switch in the sequential condition than the simultaneous condition suggests that participants are not too polite to object to the switch. That is, random assignment to conditions should have controlled for politeness, and yet the number of participants objecting to the switch differed between conditions so politeness is not a plausible explanation.

To amplify the relatively subtle sequential-simultaneous manipulation in Downs and Sobel (2015), we tried to create a procedure that would encourage all participants to engage their memory in a choice blindness task, which would result in almost all participants verbally indicating they noticed the switch. To do so, we designed a procedure for Experiment 1 that is a hybrid of the visual (face) version and the taste (jam) version of the choice blindness paradigm. In our Experiment 1, participants viewed two images of food (e.g., an image of a baked potato and another of a mashed potato) and selected the one they thought would taste better. For participants to make this kind of selection, they can't merely compare two images to select the more attractive or two tastes to select the tastier one. Instead, they need to recall their past experiences with the two foods from long-term memory and load these recollections into their short-term memory to compare them with each other. Accordingly, we hypothesized that

when asking participants to select which of two food images would be tastier, almost all participants will verbally indicate noticing the switch in switch trials. If almost all of our participants verbally indicate noticing the switch, that should undermine the suggestion that in choice blindness experiments participants really do notice the switch but are too polite to say so.

Experiment 1: Images of Foods and Faces

Method

Participants. We received permission to carry out both experiments from the University of Central Arkansas Institutional Review Board before gathering any data, and participants were treated in accordance with the ethical guidelines stipulated by the American Psychological Association. A total of 70 participants were randomly assigned to one of two conditions: similar foods ($n = 35$, 20 were women) and similar faces ($n = 35$, 27 were women). All participants were University of Central Arkansas undergraduate students who received course credit for their participation.

Materials and Procedure. We gathered 30 colored pictures of common American foods and grouped them into 15 pairs. The foods ranged from common meats (chicken, steak, etc.) and fruits (apples, oranges, grapes, etc.) to hot drinks like coffee and tea. The pictures were then printed and glued to a light blue cardboard material. Three of the pairs were to be switched, and a second copy of these images was glued to black cardstock that matched the black cardstock glued to the tabletop. For the switched pairs, we matched mashed potatoes with a baked potato, steak with chicken, and a sandwich wrap with a sandwich sub. The face images were glued to the same light blue cardboard material and black cardstock, and as in Downs and Sobel (2015), we used the same thirty grayscale faces with the same three switched pairs. During the experiment, the experimenter recorded participant number, gender, and whether participants noticed the switch on a sheet of paper.

Participants sat across the table from the experimenter throughout the experiment. The experimenter presented 15 pairs of images, one

pair at a time. Each image was held in one of the experimenter's hands for four seconds, then both images were placed face-down on the table. The participant indicated which image they preferred. The experimenter slid the selected picture across the table for the participant to pick up, examine, and explain why they chose it.

On trials 7, 10, and 14 (out of 15), a two-card ploy was used so the participant ended up with the picture they had not chosen. For these switched pairs, the experimenter actually had both pictures in each hand during the examination period, one image mounted on black cardstock that the participant could see and a second image hidden behind the first mounted on blue cardboard. For example, if the participant picked the baked potato in the experimenter's right hand, when both images were placed face-down on the table the image of mashed potatoes that had previously been hidden was now on top. The blue backing of the mashed potatoes image was much more noticeable against the black cardstock on the tabletop than the black cardstock glued to the back of the baked potato image. When the experimenter slid the blue-backed image to the participant, the previously visible image was concealed under the experimenter's arm, which then slid back across the table as the experimenter withdrew her arm. The experimenter held two images in her left hand as well, with the mashed potatoes mounted on black cardstock and the baked potato hidden behind it mounted on blue cardboard.

The same procedure was used for both conditions. If participants noticed a switch, the experiment was halted at once. Participants were judged to have noticed the switch if they verbally indicated that the image slid to them across the table was not the one they had selected. If participants were willing to describe reasons in all switch trials, the experiment continued through all 15 trials and the participant was debriefed.

Results and Discussion

In the similar faces condition, 8 of the 35 noticed the switch, leaving 27 participants not noticing. In the similar foods condition, 32 of the 35 noticed the switch, leaving 3 participants not noticing. The results of the chi-square test of

independence were statistically significant, $\chi^2(1, N = 70) = 33.60, p = .001, \phi = .69$. This finding supported our hypothesis that participants are much more likely to notice the switch for images of similar foods than for images of similar faces.

Consistent with our hypothesis that selecting the tastier of two images of food requires participants to retrieve their past experiences from long-term memory and load them into short-term memory for immediate access, almost all the participants in the similar foods condition noticed the switch. However, a skeptical reply to this result is that perhaps pictures of food make the switch *too* obvious. That is, the skeptic could claim that just as many participants in the face condition noticed the switch but they didn't mind playing along with the experimenter, whereas the obviousness of the switch in the foods condition was an affront to the participants' intelligence and they felt duty bound to object. Under this hypothesis, the switch was more obvious in the foods condition because the foods were familiar to participants but the face images depicted women unknown to participants. Thus, while we had intended to manipulate the need to engage short-term memory between conditions, there was a confound insofar as we had inadvertently manipulated familiarity as well. For that reason, we wanted to control familiarity by using the same faces in both conditions, but manipulate the distinctness of the faces in switch trials.

Experiment 2: Images of Similar Faces and Distinct Faces

Method

The method for Experiment 2 was the same as in Experiment 1 with the following exceptions.

Participants. A total of 35 (21 were women) University of Central Arkansas undergraduate students participated in exchange for course credit. None had participated in Experiment 1. The two conditions were similar faces (from Experiment 1) and distinct faces.

Materials and Procedure. Participants viewed the same images from Experiment 1, but in the distinct faces condition the image pairs for switch trials were rearranged so they were much more distinct from each other than in the similar faces condition. We paired the three switched

trials by major hair differences (short vs long, curly vs straight, light vs dark color).

Results and Discussion

In the similar faces condition, 8 participants noticed the switch and 27 did not. In the distinct faces condition, 21 noticed the switch and 14 did not. The results of the chi-square test of independence were statistically significant, $\chi^2(1, N = 70) = 9.95, p = .001, \phi = .38$, supporting our hypothesis that participants are more likely to notice the switch when the faces are distinct than when they are similar.

More participants noticed the switch when viewing distinct faces than similar faces, but not as many as when viewing pictures of food. We argue that more participants notice the switch when using pictures of food because they have to draw upon their memories and experiences with the food, but they simply don't have this opportunity when viewing faces they have never seen before.

General Discussion

Choice blindness is a fairly new phenomenon with much room left to explore. In our previous work (Downs & Sobel, 2015), we found sequential presentation of images reduced choice blindness relative to simultaneous presentation, and argued the difference was due to a stronger incentive to engage short-term memory in the sequential condition. One objection to this and other choice blindness experiments is the hypothesis that all participants do notice the switch but most do not speak up about it because they are too polite and think they are not supposed to interrupt. To test this hypothesis, we sought to amplify the need to engage short-term memory in Experiment 1 compared to Downs and Sobel by using images of common American foods. Almost all participants in the foods condition had no problem letting the experimenter know they got the wrong picture in switch trials. Whereas selecting the tastier of two images of foods relies more on memory than selecting the more attractive of two images of faces, a possible confound was the familiarity of foods versus faces. In Experiment 2, we controlled for familiarity by using faces in both conditions, and yet images of distinct faces elicited more objections to switches

than images of similar faces. This shows that the likelihood of choice blindness increases with the similarity of the two stimuli, which is consistent with the results in a study by Steinfeldt-Kristensen and Thornton (2013). In their experiment, participants manipulated physical objects like spoons, cell phones, and bracelets without being able to see them. They found that choice blindness was likelier for similar objects than for distinct objects. Similarity plays a role in choice blindness, whether the participant is viewing or touching the stimuli.

A possible limitation to our experiments is the fact that our previous experiment (Downs & Sobel, 2015) and the two experiments described here were conducted at the same university, so perhaps participants talked amongst themselves about the experiment and came to the lab primed to expect the sleight of hand trick (i.e., diffusion of treatment conditions). We have three complementary reasons to find this limitation unconvincing. First, because two of us are undergraduate students (HD and JH), we know that students enjoy talking to each other, but they almost never consider their experiences in extracurricular experiments to be worthy conversational topics. Second, if participants were telling their classmates and friends about this study involving a magic trick, the number of participants noticing switches should have increased with each experiment. Admittedly, more participants noticed switches in Experiment 1 than in Downs and Sobel, but fewer participants noticed switches in Experiment 2 than Experiment 1. Finally, when participants did notice a switch, they almost always expressed shock, and almost never understood how the switch was executed.

Our previous work (Downs & Sobel, 2015) led us to argue that choice *blindness* may be a misnomer, and a better explanation may be that participants failed to store their choices in memory rather than that they were blind to the choices. In Experiment 1, we argued that selecting which of two images depicts a tastier food should engage short-term memory more than selecting which of two images depicts a more attractive face, and once again our results supported our hypothesis that choice blindness is better explained by a failure to load the images in visual short-term memory than

JUSTIFICATION OF CHOICES NOT ACTUALLY MADE

blindness. However, the results from Experiment 2 reveal a role for visual attention in choice blindness (the 'blindness' in choice blindness is intended to convey a lack of visual attention rather than visual perception). That is, visual attention is sensitive to the salience of a stimulus, and the primary difference between similar and distinct faces was salience. We are compelled to admit that choice blindness seems to depend on an interaction between visual attention and visual short-term memory. This sets the stage for future work in which we try to tease apart the relative contributions of attention and memory to the phenomenon of choice blindness.

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Flawed Law: The Role of Time and Cognitive Load in Facial Recognition

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Abstract—This study investigated the connections between (a) time between encoding and recall and (b) cognitive load (i.e., a distractor task) when presenting a fictional police lineup to students acting as witnesses. Participants viewed target faces in an initial session, then attempted to recognize those faces in a second lineup either immediately, one week, or three weeks later. Cognitive load was manipulated via a Stroop task randomly assigned to half of the sample. As predicted, when time between encoding and recall increased, memory accuracy decreased ($p < .001$). Recall also decreased when students had a distractor task during encoding ($p < .001$), and the interaction was not significant ($p = .977$). Future research directions and implications for real-world police lineups are discussed.

Keywords: memory, cognitive load, police lineups

Imagine that you have witnessed a crime, and you are now being asked to identify the criminal in a police line-up. When the crime occurred, you were distracted by the other sights and sounds in the busy environment. Additionally, three weeks have passed since the crime occurred. How confident would you be in the accuracy of your memory and in your ability to pick out the correct face when given several choices? Memory errors are not uncommon in lineup procedures involving eyewitnesses; these mistakes have led many researchers and criminal justice professionals to call for better ways of identifying suspects. The purpose of the current study was to investigate variables related to memory and police lineups, to further advance knowledge about this important part of the criminal justice system. Specifically, this study included analyses of two relevant variables: (a) time between encoding and recall and (b) the role of cognitive load, or distraction, on facial recognition accuracy.

Time Between Encoding & Recognition

Research has found that the human mind

can do incredible things, such as encoding several images after only a few short seconds (Huebner & Gegenfurtner, 2011). Encoding is the process of moving information from perception to short-term, then to long-term memory. Huebner and Gegenfurtner studied several variables related to encoding. First, full encoding was found to require a certain minimum amount of exposure time to stimuli. Second, when multiple images were presented simultaneously, it took longer for individuals to encode a single image into memory. In other words, when only presented with one image at a time, individuals showed remarkably increased performance. Third, when individuals were tested a week after exposure, people who had more time to view the original images had better recognition than people with less original time to encode. Finally, Huebner and Gegenfurtner found the ability to distinguish between two images was negatively correlated to how similar those images were to each other. Combining across these separate findings, they concluded that presenting images with sufficient time given to encode, presenting images one at a time, and testing soon

*Wind Goodfriend served as Faculty Sponsor.

after exposure, all led to a better chance of memorization.

In general, many studies have found that the passage of time leads to less accuracy in memory. For example, trace strength models (Brown, Rips, & Shevell, 1985) suggest observed events leave memory traces in the mind, and the more time that passes between the event and accessing it in memory, the weaker the trace will be. A similar idea is the temporal sequence model (Murdock, 1974), which compares memory to a conveyor belt. Memories go through the mind in order over time, and the further away the memory is, the less precise it will be. Finally, the contextual overlap model (Glenberg et al., 1980) suggests memory will be more accurate if the person's mindset is similar during encoding and recall, and that this mindset is less and less similar over time. All three models agree that the passage of time will hurt memory accuracy, when all other variables are equal.

This variable of time between encoding and recall of faces is an extremely important one for real-world applications such as police lineups (e.g., Behrman & Davey, 2001; Shaw, McClure, & Dykstra, 2007). If more than a week goes by between a crime and the identification of the suspect, it is possible that accuracy in the identification will suffer greatly. Thus, it is important to further understand the role of time in memory accuracy. Based on the research summarized above, it was hypothesized for the current study that time between encoding and recall of faces would negatively impact recognition.

Cognitive Load in Facial Recognition

Many studies have explored cognitive load and how it affects recognition after encoding. Cognitive load is the level of demand placed on an individual's working or short-term memory (Klemen, Büchel, Bühler, Menz, & Rose, 2009). Under high cognitive load, memory abilities are decreased due to distraction and multi-tasking. For example, one study showed that participants who had to complete a color-sorting task while encoding had worse memory, especially when stimuli to be encoded were presented very quickly or when participants were older individuals (Baumans, Adam, & Seron, 2007). Another example that is particularly relevant to the current study

was research showing that when participants had to recognize names of famous people (such as musicians or politicians), distractor faces shown during the task decreased their memory performance (de Fockert, Rees, Frith, & Lavie, 2001). This distraction effect of cognitive load serving as a barrier to correct or complete encoding is a consistent research finding (e.g., Lavie, Hirst, de Fockert, & Viding, 2004; Loftus, 1980; Van Dillen & Derks, 2012).

However, other research has found a lack of effects from cognitive load. For example, Nortje and Tredoux (2012) studied how distracting individuals with an irrelevant task might take away from the processing of faces, but the individuals could still recognize faces from their in-group, despite the distractor. Another study analyzed the effects of distractor voices and faces in the recognition of target voices and faces (Stevenage et al., 2013); results indicated that distraction did not have a significant impact on facial recognition.

Even though a few studies have found that cognitive load is not a highly influential variable, most research indicates that distractors while encoding do decrease accuracy, as briefly reviewed above. However, few studies combine and test the main effect and interaction of cognitive load with additional variables, such as time between encoding and recall. In the current study, it was hypothesized that individuals in a high cognitive load group (distractor group) would be significantly less likely to correctly identify faces in a lineup, compared to individuals in a non-cognitive load (control) group.

Thus, the hypotheses in this study were:

H1: Time between encoding and recall of faces would negatively impact recognition.

H2: Cognitive load would negatively impact facial recognition.

In addition, an interaction was expected, such that the worst facial recognition would occur for participants in the group with the most time between encoding and recall and who were under cognitive load during encoding.

Method

Participants

This study consisted of 73 students from introductory psychology classes and varying levels of criminology classes from a small, private, Midwestern university (34 men and 39 women). Four participants were excluded from analyses because they personally recognized at least one of the individuals photographed and used for the experimental stimuli. Participants were offered extra credit for their participation. Demographics were as follows: 64.38% freshmen/transfers, 21.92% sophomores, 5.48% juniors, and 8.22% seniors/fifth years or more. The mean age of the participants was 19.27 years ($SD = 1.53$). Race/ethnicity was not measured, but students at the university in general are predominately White/Caucasian.

Procedure

Participants were tested in a classroom with four levels of seating (auditorium style); most participants were seated in the second and third rows. The screen was located at the front of the classroom and all objects were removed from in front of the screen for optimal viewing. On average, five participants were run at a time (range from two to ten people). Participants first were asked to print their name and email address on a sheet of paper with a number and one of three letter assignments (*a*, *b*, or *c*). Participants were then asked to read and sign a consent form; all participants then viewed the first series of faces (described below). Half completed a Stroop task during the session (again, described below). Next, participants filled out a demographic sheet asking about age, sex, year in school, and whether they had been convicted of a felony (none of the participants were felons). After participants were finished viewing the photographs, participants who were *a*'s on the signup sheet were asked to stay while the other participants were told that they would receive an email informing them when their next session would be held.

During the second session, the participants were shown another PowerPoint with 15 female photographs (5 matching target faces) and 15 male photographs (again, 5 matching target faces) and asked to circle numbers indicating which faces

they recognized from the first series. After the facial recognition task, all participants were debriefed and asked if they had any questions. This research was approved by the hosting university's Institutional Review Board for ethics.

Materials

Target Faces. All participants were asked to view a series of 20 photographs (10 men, 10 women) projected sequentially on a screen at the front of a classroom, then later asked to identify which faces were familiar from a second series of 30 photographs (15 men, 15 women). Five of the male and five of the female faces were identical in both series (i.e., 10 faces matched), and these were the "target" faces. All of the photographs were taken from a publicly available database of convicted criminals from Arizona, Arkansas, Alabama, and Mississippi (Mug Shots Database, 2013). How these photos were presented varied based on a 3 (time to recall: immediate, one week, three weeks) X 2 (cognitive load: Stroop vs. control) factorial design. Both manipulations were randomly assigned; see below for details.

IV1: Time to recognition. Within all of the sessions, participants were randomly assigned to the immediate, one week, or three week condition regarding how much time passed between viewing the target faces and being asked to recognize them. This process was done by having the participants write their name and email address on a line next to a number and a letter, as they arrived for the study session. The letter signified to which of the three time conditions they would be assigned. Participants in the two delayed conditions (one week and three weeks) were sent emails informing them of the day and time they were to participate in the second session. The participant numbers reported above are only for individuals who completed both sessions and thus were included in analyses.

IV2: Cognitive load. Half of all sessions included the cognitive load task, which was a written Stroop task. Each participant within these sessions was presented a Stroop card and a piece of paper on which to write their responses. Each card had a list of 25 words that spelled a color but appeared in ink that did not match (e.g., the word "green" printed in yellow ink). Participants were

asked to write, on a separate sheet of paper, the written color (not the ink) of all 25 words as quickly as possible. Importantly, participants were to complete the Stroop task while viewing the PowerPoint of target faces during the first session. After the session was complete, participants were allowed to keep their Stroop answers if they desired. For the control condition (no distractor task), participants simply completed the demographics questionnaire, viewed the faces, and were asked to complete the recall task at their randomly assigned time.

DV: Accuracy in Facial Recognition.

Accuracy was analyzed by the amount of correctly recalled faces at the second session. Participants were given a sheet with the numbers 1-30, and then asked to circle any numbers that corresponded to faces they remembered from the first series of photographs. Participants could thus recall anywhere between zero to ten of the original target faces from the first session. In addition, note that 20 of the faces at the second session were new, distractor faces, but participants could report false positives and “recall” faces they had not actually seen before. Participants were not told how many of the faces were matches from the first session. Faces identified as matches that were not correct (i.e., false positives) were subtracted from the total score of correct matches; this resulted in a possible range of -20 to 10 accurately recalled faces. Overall (across all conditions) the mean number of correctly recalled faces from this sample was 2.01 ($SD > 7.2^6$), with an actual range of -7 to 10.¹

Results

An analysis of variance (ANOVA) was completed to test for the two main effects and the interaction; see Table 1 for all means and standard deviations. First, the interaction between time to recall and cognitive load was not significant, $F(2, 55) = 0.02, p = .977, \eta^2 < 0.01$. However, both main effects were statistically significant. Supporting the first hypothesis, time between viewing the faces and being asked to remember them did affect

memory accuracy, $F(2, 55) = 12.29, p < .001, \eta^2 = .203$. Participants allowed to complete the recall task immediately had the highest accuracy ($M = 3.95, SD = 3.06$) followed by participants who had to wait one week ($M = 1.74, SD = 3.63$), and participants asked to wait three weeks ($M = 0.24, SD = 3.58$). Tukey post-hoc contrasts showed all three means were different from each other at $p < .05$. Also supporting the second hypothesis, participants who tried to encode faces while also completing the distractor task (i.e., the high cognitive load condition) had significantly worse memory accuracy ($M = -0.28, SD = 3.05$) compared to participants in the control group ($M = 4.03, SD = 3.03$), $F(1, 55) = 44.12, p < .001, \eta^2 = .365$. In sum, both hypotheses were supported.

Discussion

Results confirmed that (a) time between encoding and recall and (b) cognitive load both had a significant effect on facial recognition accuracy in the expected directions. Time between initial encoding and recall made memory worse, as did a distractor task at the time of encoding. This is relevant to criminological and psychological research on police lineups because it shows that it is better to bring the victim/witness in to do a lineup closer to the time the crime occurred, rather than waiting, when possible (Glenberg et al., 1980; Huebner & Gegenfurtner, 2011; Murdock, 1974). It also supports previous research (Lavie et al., 2004; Loftus, 1980; Van Dillen & Derks, 2012) that suggests individuals who are distracted are unable to recall faces as accurately as an individual who was not distracted when the event occurred. These findings should be used to help better the work of policing, especially in the use of eyewitness testimony. For example, though police may not be able to control whether a witness is distracted or not, the level of distraction could be taken into account when considering how accurate the witness may be. Line-ups or questioning sessions regarding what happened during the original event

Footnote

¹ We also analyzed the data using a slightly different measure of the dependent variable. In this alternate method, we used proportions of correctly recalled faces (i.e., # of correct hits / 10) and false positives (i.e., # of false positives / 20) and subtracted the false proportion from the correct proportion. This method resulted in the same pattern of results, with the main effects for time ($p < .001$) and cognitive load ($p < .001$) remaining significant, and the interaction remaining not significant ($p = .95$).

Table 1. *Memory Accuracy for All Conditions*

	<i>n</i>	<i>M</i>	<i>SD</i>
High Cognitive Load			
Immediate recall	11	1.82	2.32
One week delay	8	-0.75	2.76
Three weeks delay	10	-2.20	2.70
Low Cognitive Load			
Immediate recall	10	6.30	1.77
One week delay	11	3.55	3.14
Three weeks delay	11	2.45	2.77

Note. Memory accuracy could range from -20 to +10.

should also take place as immediately as possible.

Limitations and Future Research

One limitation of this study was that the researchers failed to ask participants to report their race/ethnicity. This oversight prevented any analysis regarding ethnic differences in reactions to faces, and it makes it difficult to know how generalizable the results are. Faces were also presented sequentially, rather than simultaneously. In most actual police line-ups, the suspect and distractors would be presented simultaneously instead, so this change may limit the external validity of our particular procedure. Another possible criticism of the procedure was the choice of cognitive load manipulation, in that the Stroop task required participants to look away from the faces in order to complete it. Thus, the lower facial recognition accuracy may have been due to increased cognitive load, but it may also have been due to the confounding variable of less time actually looking at the target faces. Future research could eliminate this problem by including a distraction task that was audible or completely cognitive (e.g., keeping track of arithmetic or long strings of numbers in one's head).

In addition, having more participants would have greatly impacted the analyses by providing a more diverse sample. The original intent of the study was to include additional predictor variables

such as gender or self-reported criminal status, but the sample did not provide enough diversity or statistical power to test for effects of these constructs. Several other important ecological variables may have an influence on accuracy in a police line-up situation, and future research may wish to explore both the role of these variables individually and in terms of their interactions with the passage of time and cognitive load. For example, participant sex may have an influence on accuracy of facial recognition, especially when the target faces are both male and female. Lewin and Herlitz (2002) found that women are better at facial recognition (especially when remembering the faces of other women) and speculated that this may be due to cultural practice, such as viewing faces of women in magazines. Both Herlitz and Yonker (2002) and Palmer, Brewer, and Horry (2013) found that women out-performed men in facial recognition tasks. Palmer and colleagues (2013) specifically found that divided attention during encoding impaired memory accuracy for female target faces more than for male target faces. Thus, sex of both the participant and the target might matter and might interact with distraction and cognitive load. The low sample size of the current study prevented the authors from being able to accurately test for interaction effects with multiple predictor or independent variables, but this could be explored in the future.

Another example of a potentially important variable might be criminality bias or bias that could arise from social categorization and labeling effects. Previous research has analyzed how labeling biases and prejudice toward out-groups (e.g., “criminals”) affects encoding and memory (Bernstein, Young, & Hugenberg, 2007; Hugenberg & Bodenhausen, 2004; Hugenberg, Bodenhausen, & McLain, 2006; Young, Bernstein, & Hugenberg, 2010; Young & Hugenberg, 2010). Importantly, one study showed that individuals who “look like a criminal” (i.e., appear to have more stereotypical criminal features) more than the actual perpetrator will be more likely to be picked out of the lineup by a victim or witness (MacLin & MacLin, 2004). Again, this construct could be included in future research to test whether it interacts with variables such as time and cognitive load.

Conclusions and Applications

This research could be used to help further the investigative and line up procedures that police officers and detectives use in their day-to-day work. Many citizens believe that the way the criminal justice system is currently run is the right way. This study found that accurate recall of faces may not be as straightforward, simple, and easy as it seems. Previous studies have highlighted common errors found in eyewitness studies, and these errors were supported by the results of the current study. This research and others could be used to teach individuals, such as officers and other related personnel, about more accurate ways to perform a lineup procedure (Kemp, Pike, & Brace, 2001; Memnon, Havard, Clifford, Gabbert, & Watt, 2011). Police practices should be based on statistical evidence for what is—and is not—effective in correctly identifying criminals; these policies and procedures should be updated to account for modern psychological research.

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Hearing Colors and Tasting Words: A Literature Review on Innate vs. Acquired Synesthesia

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Abstract—This review analyzes current literature on the topic of synesthesia, a condition in which two unrelated senses experience cross-activation resulting in abnormal sensations. A division among the literature is recognized and the review aims to answer the question: Can true synesthesia be acquired? The condition is generally reported in the literature as developmental, acquired through injury/illness, or drug-induced. Prominent research in the field looks at the biological and genetic basis, as well as ongoing symptomology. Case studies and empirical research are reviewed finding that acquired synesthesia does not necessarily hold the consistent, persevering qualities of developmental synesthesia, especially when acquired through drug use. Thus, at least some forms of acquired synesthesia are not equivalent to developmental forms. It is further suggested by this literature review that the scientific community view synesthesia not in reference to how the condition came about, as much of the current literature does, but rather in terms of chronic versus acute symptoms .

Keywords: synesthesia, innate symptoms, acquired symptoms

“It doesn’t make any sense to me how any person can think about an alphabet without brilliant colors. It seems like it would be really boring.” (PBS, 2011). As a research scientist in cognitive psychology, Steffie Tomson applies her personal experiences to the study of synesthesia. Synesthesia is a condition in which the senses cross, causing one sensory stimuli to act as a trigger for a second sensory stimuli in a different modality. Synesthesia researchers Brang and Ramachandran (2011) report that over 60 forms of synesthesia have been documented, though some forms, such as grapheme-color, may be more prevalent in the population. This review aims to focus on the forms of the condition most prevalent and relevant in the literature. Documented accounts of this condition began in the 1600s with John Locke telling of a man who could hear colors; it wasn’t until the 1880s that Francis Galton first referred to the condition, providing a more detailed case study description (Pearce, 2007).

The theorized prevalence of the condition

varies widely, as research on the topic has progressed. Historical estimates from the early 20th century placed the prevalence rate as high as 25%; however, in recent decades those estimates have decreased significantly to 0.5-4% (Simner et al., 2006). Simner and colleagues note that prevalence rates near 4% may be an overestimate caused by methodological vulnerabilities to false positives. Among synesthetes, up to 65% see letters and numbers in color, much like Steffie Tomson (Gibson, Rodvansky, Johnson, & Mc Nerney, 2012). Others may taste names, hear colors, feel sounds, or possess other combinations of sensory experiences. A few empirical studies suggest synesthetes have the capacity for superior working memories and greater creativity (Gibson et al., 2012; Ramachandran & Hubbard, 2001; Terhune, Wudarczyk, Kochuparampil, & Kadosh, 2013). Grapheme-color synesthetes have also shown enhanced abilities in numeracy by using color to determine the magnitude of a number (Kadosh, Tzelgov, & Henik, 2006).

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Although most synesthetes report their symptoms as pleasant and non-intrusive to their everyday lives, personal accounts from other synesthetes sometimes tell a different story. One such example is the case of James Wannerton, whose lexical-gustatory synesthesia causes him to taste names. He explains his condition, "If I don't like the taste of someone's name I won't like them. It sounds a bit harsh and irrational but it's a fact" (America's Test Kitchen, 2015). R. E. Cytowic (2002) also describes multiple cases of synesthetes with aversive experiences. One patient expressed that viewing advertisements causes frustration because the colors of words do not match his synesthetic perception. A common complaint of synesthetes has also been the emotional distress they feel from family and friends who believe them to be lying about their condition. It is important to approach claims of synesthesia with seriousness, however, because a greater understanding of the condition can benefit other areas of neuropsychology.

Because synesthesia has been associated with abnormal sensory connections in the brain, researchers believe information about synesthesia might provide insights into conditions like autism (Bouvet, Donnadiou, Valdois, Caron, Dawson, & Mottron, 2014; Neufeld et al., 2013) and schizophrenia (Senkowski, Schneider, Foxe, & Engel, 2008), as they have also been associated with abnormal neural connectivity. Recently, researchers found a significant association between abnormal neural connectivity and Posttraumatic Stress Disorder (PTSD). In the empirical study, results indicated that 6% of veterans with warzone deployment experience and PTSD tested positive for grapheme-color synesthesia (Hoffman, Zhang, Erlich, & Boscarino, 2012), suggesting possible implications for PTSD screening and treatment.

In the current literature, we find a divide largely between studies of patients with developmental, or innate, synesthesia and patients who acquired it later in life, either through a medical condition or illicit drugs. Researchers have found synesthetic-like pathology in victims of stroke, progressive blindness, and users of hallucinogenic drugs (Addy, Garcia-Romeu, Metzger, & Wade, 2015; Ahmadi, Keshtkar, &

Pridmore, 2011; Armel & Ramachandran, 1999; Brogaard, 2013; Fornazzari, Fischer, Ringer, & Schweizer, 2012; Gubernick, Ameli, Teng, Velez, Heilman, & Hedna, 2014; Krenzelok, 1996; Leikin, 1996). Some psychologists argue the only true form of synesthesia is developmental and acquiring it later in life does not prove to be the same (Deroy & Spence, 2013a; Deroy & Spence, 2013b). Others believe all forms of synesthesia are comparable because patients manifest the same types of symptoms no matter how the condition came about, including through medical injury or drug use. For the purpose of this review, the singular term *synesthesia* is used throughout, but the truest form of synesthesia is considered "unsuppressable" (Cytowic, 1995) and requires that the patient is able to maintain cross-modal experiences on an ongoing basis without a repeated stimulus such as injury or drug use. This literature review looks at evidence on both sides of the debate and aims to answer the question: Can true synesthesia be acquired or must it only be present from birth?

Developmental Synesthesia

Ophelia Deroy, Associate Director for the Centre for the Study of the Senses and Institute of Philosophy at the University of London, has been an outspoken voice in the synesthesia research community. Over a dozen of Deroy's papers on synesthesia and cross-modal experiences have appeared in numerous academic journals providing support for why acquired and drug-induced synesthesia is not comparable to developmental, innate synesthesia. Her research has concluded not all cross-modal correspondences are necessarily synesthetic, although they may appear so on a superficial level (Deroy & Spence, 2013b). Although acquired cross-sensory experiences exist, Deroy suggests true synesthesia can only develop innately and is likely based on genetic factors (Deroy & Spence, 2013a).

Other researchers have confirmed support for a genetic basis for developmental (innate) synesthesia, although scientists have not yet pinpointed a singular or definitive set of chromosomes responsible for its expression. Approximately 40% of synesthetes self-report a first-degree relative with the same condition. V.S.

Ramachandran is at the forefront of research on the neurological workings and genetic basis of synesthesia. He believes there may be a serotonin-linked chromosome responsible for the expression of the condition (Brang & Ramachandran, 2011). No literature, however, has been able to link acquired forms of synesthesia to genetics.

In addition to clues in the genetic code, researchers have found an association between developmental synesthesia and structural differences in the brain. Using brain imaging on grapheme-color synesthetes, increased connectivity has been found in the superior parietal lobe (Rouw & Scholte, 2007). Brain imaging showing cross-wiring in the fusiform gyrus, which resides in the temporal lobe, has also been significant in understanding grapheme-color synesthesia (Ramachandran & Hubbard, 2001). Among synesthetes, there have even been differences found in the brain structure depending on how the individuals experience the condition. Those individuals who are known as *projectors* see colored letters physically in front of them, whereas *associators* only see the color in their minds' eye. Projectors have been documented to have greater connectivity in their inferior temporal cortex, as compared with associators (Rouw & Scholte, 2007).

Interestingly, this literature review found a case study of acquired auditory-visual synesthesia using brain imaging to determine the possibility of structural differences. Afra and colleagues (2012) described a 42-year-old woman who began gradually acquiring synesthetic experiences in her late 30s, with no mentioned relation to drug use or brain injury. The researchers believed cross-modal sensory pathways might have existed but remained dormant until the time her experiences manifested. Brain images, including EEG and fMRI, were taken, but all returned normal. No significant structural differences could be found. This study, in particular, provides unique insight because it suggests that, at least in some cases, developmental versus acquired synesthesia may not, in fact, be the same.

Other empirical studies provide supporting evidence for the disinhibited feedback theory. This theory contends that the neurological basis of synesthesia is a result of uninhibited feedback from

the parietal cortex to sensory areas. Support for this theory has been based on empirical studies using fMRI data from limited sample sizes of around 14 participants (Neufeld et al., 2012). Though these findings conflict with the theory of hyperconnectivity, they provide an alternative explanation to abnormal neural functioning that demonstrates the biological basis for developmental synesthesia, which may not be present with acquired forms. As with all studies on the topic, readers must take caution to not over-generalize results due to the limited pool of participants.

R. E. Cytowic (1995) found evidence suggesting the neural basis for synesthesia lies in the left hemisphere of the brain. His research led him to further conclude that, no matter the form of synesthesia, the hippocampus is likely a key structure. Ramachandran and Hubbard (2001) later documented the previously mentioned case study that theorized a patient's synesthetic symptoms were linked with the hippocampus.

Cytowic (1995) described his own case study in which he found a synesthete showed up to an 18% decrease in cortical metabolism while undergoing a synesthetic experience, which, Cytowic explains, cannot be re-produced in a laboratory even with drugs. This is because one would expect a person experiencing a decrease in cortical metabolism of this magnitude to show signs of blindness or paralysis. Although this evidence is only based on a single patient, it shows people with developmental synesthesia may experience neurological changes that cannot safely and naturally occur in otherwise normal individuals who might experience drug-induced symptoms.

Acquired Synesthesia through a Medical Condition

Most of the research supporting the idea that acquired synesthesia is, in fact, a genuine form of the condition is based on case studies. No matter which sensory modalities are intertwined, the literature generally supports that synesthesia can be acquired in one of two ways: injury/disease and drug-induced.

Psychologists have speculated that it can come about as a result of progressive

deafferentation or prolonged destruction of sensory nerve cells in the brain. Armel and Ramachandran (1999) theorized this deafferentation is responsible in cases of patients who experience blindness. They reported the case study of a man who experienced tactile-visual synesthesia following total blindness two years earlier. This phenomenon was attributed to the progressive deterioration of sensory nerve cells.

Stroke victims have also been documented as having synesthetic-like symptoms. One case study of a 74-year-old stroke victim found the emergence of visual-olfactory synesthesia (Gubernick et al., 2014). The stroke victim had been blind in one eye since childhood and therefore experienced progressive deafferentation. After she had a stroke, she began to see visual hallucinations that were soon accompanied by odors. Doctors did not find the acquired synesthesia to be related to the deteriorated visual nerve cells because the stroke victim's visual cortex and olfactory brain areas were not physically close. In synesthesia, it is most common to find two senses cross when they are activated in close proximity in the brain (Ramachandran & Hubbard, 2001). The medical team believed her acquired synesthesia was instead caused by hyperactivity in the damaged visual cortex, which relayed signals to the olfactory system via the hippocampal region of the cerebral cortex (Gubernick et al., 2014). Looking at this and the previous case study, it is clear there is no distinct neural basis of synesthetic symptoms, even when the causes seem similar. Although there have been multiple documented cases of synesthesia following blindness, research has yet to equate the abnormal brain structures in patients who acquire synesthesia through injury or disease to those born with the condition.

The current literature on synesthesia also documents other experiences with stroke-related synesthetic symptoms. The literature presents a case study of a 45-year-old man who suffered a thalamic stroke (Fornazzari et al., 2012). After experiencing the stroke, he acquired not one but three forms of synesthesia: sound-tactile, sound-color, and grapheme-gustatory. Following a traumatic brain injury such as a stroke, serotonin and glutamate flood the brain. It is thought this

could be responsible for increasing the excitability and connectedness of sensory regions (Brogaard, 2013). Brang and Ramachandran (2011) provided further support for this when they discovered synesthesia may be related to a serotonin-linked chromosome. Again, there is no definitive evidence pointing to the activity in the brain causing these symptoms in acquired synesthesia. Science has really only been able to provide speculation.

Acquired Synesthesia through Drug Use

Some research has also linked synesthetic symptoms with hallucinogenic-type drugs, such as psychedelic mushrooms, LSD, morning glory seeds, marijuana, Salvia, and phencyclidine (Addy et al., 2015; Krenzelok, 1996; Leikin, 1996). Case studies on drug-induced synesthesia have provided unique support for why it may not be comparable to developmental synesthesia. The findings of the following research support the idea that symptoms from synesthesia acquired through drug use lack the persistent and ongoing qualities of developmental synesthesia.

Ahmadi et al. (2011) reported the case of a patient who experienced color-auditory synesthesia after using methamphetamine. After years of abuse with this and other drugs, he began to have various hallucinations including colors that would talk to him through the carpet. After pharmaceutical solutions failed, doctors attempted electroconvulsive therapy (ECT). ECT is a treatment typically used for depression and related disorders that involves a patient undergoing general anesthesia while receiving a series of non-invasive electrical shocks to the brain which stimulate short-lived seizures (Leong, Tham, Scamvougeras, & Vila-Rodriguez, 2015). Over four sessions of ECT, it was reported the synesthetic symptoms ceased, and the patient returned to a healthy state. This raises questions about whether drug-induced synesthesia is a true form of the condition. If four sessions of electroconvulsive therapy can rid a patient of the acquired condition, can it be considered to be on the same level as developmental synesthesia, which is present for life?

One flaw in some research with drug-induced synesthesia has been poly-drug usage. A typical drug user will not always use just one

substance, but rather a combination of substances. When studying any type of drug-related topic, this behavior makes naturalistic research more difficult because a specific effect cannot be definitively tied to a certain drug. An example of this has been with research into the connection between synesthesia and *Salvia Divinorum*, a Mexican herb smoked recreationally for its hallucinogenic effects. Even in a laboratory setting, one particular study failed to monitor participants to ensure they had no other drugs in their system before conducting the experiment (Addy et al., 2015).

Opposing Literature

One particular case of acquired synesthesia involved no connection to brain injury, disease, or drug use. Rather, Alstadhaug and Benjaminsen (2010) described a 40-year-old woman who experienced visual-auditory and visual-gustatory symptoms in conjunction with migraine headaches. Even though it is known that migraine sufferers may experience visual auras before the onset of a headache (United States Library of Medicine, 2014), this particular patient reported perceptions of flickering lights that sounded like screaming children. She also claimed that looking at bright lights before the onset of a migraine provoked the taste of lemons. The ongoing migraine headaches were co-morbid with clinically diagnosed bipolar disorder. However, researchers ultimately did not find this to play a role in the occurrence of her experiences. Alstadhaug and Benjaminsen instead proposed the visual-gustatory symptoms were attributed to memory-based associations (i.e., the color yellow and the sour taste of lemons are commonly associated among the general population). With the visual-auditory experiences, the researchers determined it was likely caused by cortical spreading depression, an electrophysiological effect in the brain caused by migraine headaches.

Although the vast majority of research and case studies on synesthesia are related to medical conditions and drug use, a few pieces of literature have recently emerged explaining this phenomenon in alternative contexts. Colizoli, Murre, and Rouw (2012) performed an empirical study in a laboratory setting using non-synesthetic

participants. They aimed to explore whether grapheme-color synesthesia could be acquired through reading colored text. Participants read books (with greater than 49,000 words) in colored text and performed a Stroop task afterward. Colizoli and colleagues found participants performed better on the task after having been exposed to letter-color pairings in their reading. This suggested the possibility that synesthesia could, in fact, be acquired by anybody without necessarily experiencing brain/nerve damage or drug use. After a follow up study several months later, it was determined that participants did not retain the letter-color pairings, as they did not perform any better than a control group on a follow-up Stroop task. Members of the experimental group's performance only remained high or improved if they had continued to read books with the letter-color pairings, meaning the consistency between the experiment and follow-up was attributable to rehearsal and not necessarily a real synesthetic connection.

Conclusion

Based on the literature, there is a clear dichotomy between synesthesia that is innate versus acquired. In fact, much of the research on the topic centers on the condition in one of the three forms: developmental, medically acquired, and drug-induced. The literature indicates synesthesia can, in fact, be acquired but not always in the same clinical sense as those with innate, developmental forms experience it. The prevailing view on this condition seems to show drug-induced synesthesia as more transient and synthetically acquired. Developmental and trauma-acquired synesthesia tends to be portrayed as the byproduct of neuronal abnormalities. Therefore, after reviewing the existing literature on this topic, it can be concluded that synesthesia in its truest forms can only be acquired through lasting changes in the brain or be present from birth. Experiences as a result of drug use do not appear to qualify as having synesthesia in the same way as patients who were born with the condition. Nonetheless, we still know that a user of LSD and a stroke victim may manifest similar symptoms.

For this reason, this literature review proposes the innate versus acquired divide that

prevails the current body of research may not be the most effective way to differentiate forms of this condition. Based on accounts of synesthesia in the literature, researchers would be better served to make a paradigm shift in how they classify patients. Though developmental and trauma-induced forms may not have the same origin, the effects are similar in that they generally tend to be longer lasting and usually permanent. Synesthetic effects of psychedelic drugs are generally short-term. Researchers and practitioners need a way to distinguish between levels of severity of synesthesia. Thus, it is proposed that a more effective way to label different forms of the condition is by differentiating between those that occur on a chronic basis versus acute.

Chronic forms of synesthesia have consistent and persistent symptoms. This would include developmental and most cases of acquired synesthesia. At this time, our understanding is that acute forms, like drug-induced synesthesia, are ephemeral and do not reflect ongoing changes or abnormalities in brain structure and connectivity. This proposed new perspective mirrors that of the larger medical community who oftentimes distinguish acute versus chronic forms of diseases when forming a diagnosis (Lewis, Dirksen, Heitkemper, & Bucher, 2014).

Referring to the case study of the male patient with methamphetamine-induced color-auditory symptoms, we see a clear example of acute synesthesia (Ahmadi et al., 2011). Through non-invasive therapy, he was able to stop the symptoms and return to a normal life. Additionally, the empirical study whose authors concluded that grapheme-color synesthesia could be taught but only with short-term results (Colizoli et al., 2012) provides support for a shift in classification paradigm toward acute versus chronic labels.

The symptoms of all synesthetes are fundamentally identical (some type of cross-modal sensory experience), but we know the origins and duration of symptoms are not identical. As research on the topic continues to proliferate, the psychological research community becomes better informed on the origins and neurological workings behind this phenomenon. While the body of literature grows and researchers understand the deeper complexities of the condition, we must

begin to put research into classifications that reflect those complexities.

Future research can provide an even better understanding of this classification between forms of synesthesia by exploring whether or not developmental synesthesia might also be disrupted or eliminated through electroconvulsive therapy. Most synesthetes tend to report their condition provides no significant disruption to their everyday lives and thus there is unfortunately no documentation found in this literature review of individuals wishing to rid themselves of the developmental condition. To improve the validity of all research on synesthesia, researchers must also overcome the obstacle of small sample sizes. Perhaps with greater awareness of the condition and current research efforts, synesthetes who may otherwise never participate in research may become better connected to the scientific community that seeks to learn about their condition. It is common for people with synesthesia to believe that others perceive the world around them in the same way, that nothing about their perception is abnormal (Cytowic, 1995). Psychological researchers may be better equipped to recruit larger numbers of participants and increasingly move from case study-based information toward empirical research. This challenge, however, will likely remain ongoing as is typical of rare conditions.

Improved knowledge about synesthesia clarifies the intricacies of the condition and may provide more evidence suggesting innate and acquired forms of synesthesia are not necessarily comparable. The synesthetic research community can thus far conclude that, despite appearing superficially similar, synesthesia in its truest forms cannot necessarily be acquired.

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Why Does Visually Ambiguous Motion Reverse?

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Abstract—When a visual stimulus is ambiguous, the conscious visual experience contains just one of the two possible interpretations for several moments, then switches to the other interpretation and so on indefinitely. A common example is structure-from-motion (SFM) in which a rotating globe appears to spin one direction around its axis then spontaneously switches to spin the other direction. Bottom-up factors which occur in early visual processing make rotating SFM globes appear to reverse direction as the result of adaptation in motion-sensitive neurons. The rotational direction of SFM globes is also affected by context, a top-down factor in higher-level processing such as a globe that appears to be frictionally driven by an adjacent globe. Both adaptation and context can influence the perceived interpretation of ambiguous SFM. These bottom-up and top-down processes suggest that neither factor is exclusively responsible for the perceptual changes experienced. In this literature review, we investigate the underlying mechanisms which lead to multiple interpretations of the same figure.

Keywords: visual ambiguity, structure-from-motion, neural fatigue, adaptation, perceptual reversals

Vision is hard. The brain must constantly reconstruct a mental model of the world from two flat retinal images projected by the eyes' optics. Although the job of reconstructing a model of the world from retinal images—a process called inverse optics—may initially seem as if it should be straightforward, inverse optics is actually an exceedingly difficult problem (Purves, Wojtach, & Lotto, 2011). To appreciate why, consider the retinal image of the solid bar in Figure 1. The image is consistent with a medium-sized object at a medium distance (the solid bar), but the same image could have been projected by a large, distant object, or a small, nearby object, as indicated by the two dashed lines. For any retinal image, there are an infinite number of real-world objects that could have projected that image. To solve the inverse optics problem, vision relies on past experiences encoded in memory and the genes to select the mental model that is likeliest to match the real world object (Purves et al., 2011). What happens when two mental models are equally likely to match the real world object?

Visual ambiguity

When confronted with a visual stimulus for which two interpretations are equally likely, the brain selects one interpretation for several moments, then selects the other interpretation, and the conscious visual experience continuously oscillates between the two interpretations (Leopold & Logothetis, 1999). This can be seen with the classic Necker (1832) cube in Figure 2, discovered by the Swiss crystallographer Necker while examining a microscopic image of a crystal lattice. Visually ambiguous stimuli like the Necker cube were mostly overlooked by experimental psychologists during the first half of the twentieth century because perceptual reversals were not readily accommodated by the stimulus-response paradigm, which predominated at the time (Orbach, Ehrlich, & Heath, 1963). After all, the stimulus remains constant as the mental image continually changes, so the stimulus does not uniquely specify the mental response.

*Kenith Sobel served as Faculty Sponsor.

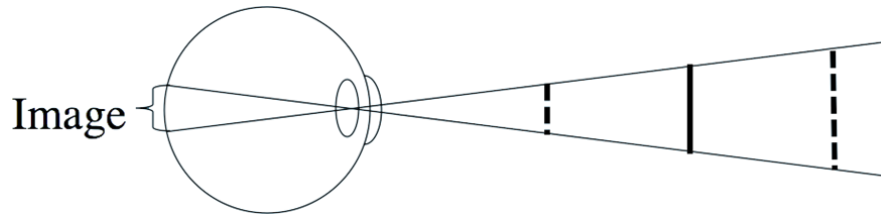


Figure 1. The inverse optics problem.

Factors Influencing the Apparent Rotation of SFM

In this section, we consider a kind of visually ambiguous stimulus called structure-from-motion (SFM). The original SFM display described by Wallach and O'Connell (1953) was created by bending a wire into a complicated three-dimensional shape and projecting its shadow onto a flat screen. When the wire was twirled, its projected shadow suddenly took on the appearance of a three-dimensional object, even though participants could only see a flat projected image. More recent versions of SFM are commonly created by developing computer animation software depicting a transparent globe with dots scattered randomly across its surface (as shown in Figure 3). At each moment, half of the dots drift to the right and half drift to the left. As the dots move about on the computer screen, they generate a clear sense of a globe rotating around its axis in the mind of the viewer, even though the dots are presented on a flat computer screen. Like other ambiguous stimuli such as the Necker cube, the globe spontaneously and unpredictably appears to

reverse its rotational direction after several moments, even though the stimulus has not changed. Why do these reversals occur?

Two kinds of factors influence the apparent rotational direction of ambiguous SFM: a) aftereffects due to neural adaptation in early visual processing, and b) grouping between an SFM globe and its surrounding context (Mareschal & Clifford, 2012). In the language of vision science, adaptation is a kind of bottom-up factor and context is a top-down factor (McMains & Kastner, 2011). We will review the evidence supporting both kinds of factors, beginning with adaptation.

Early Visual Processes Influencing Apparent Rotation of SFM

Adaptation occurs when an observer views one kind of stimulus for an extended duration, such as when watching the credits scroll slowly upward on the movie screen at the end of a movie. After the credits roll, the copyright information appears and remains fixed in the middle of the screen. Even though the copyright information is actually stationary, it briefly appears to drift downward, in

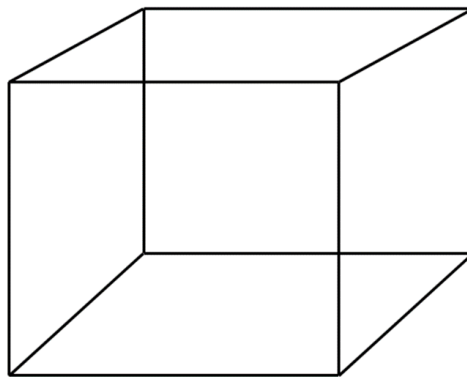


Figure 2. The visually ambiguous Necker cube.

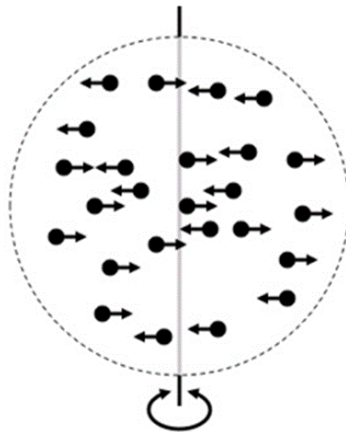


Figure 3. A structure-from-motion globe. Half of the dots drift to the right and half drift to the left. At any one time the conscious visual experience contains either a globe rotating clockwise (as seen from above) or counterclockwise, and the rotational direction periodically reverses.

the opposite direction as the adapting (upward) motion. Illusory motion following adaptation is the result of neural fatigue (Niedeggen & Wist, 1998). In the early stages of visual processing in the cortex are neurons that respond to motion (Livingstone & Hubel, 1988). Some neurons are selective for downward motion and others to upward motion (as depicted by the bell curves in Figure 4a). The bell curves represent the fact that neurons respond best to one speed and direction, less well to similar speeds, and not at all to very

different speeds. The vertical line in Figure 4a represents a stationary (non-moving) stimulus. Even though the stimulus is stationary, it elicits a response from motion-sensitive cells represented by the intersection between the vertical line and the bell curves. Because both intersections are the same height above the x-axis, the overall neural response to a stationary stimulus is balanced. Extended viewing of upward drifting movie credits makes the upward-sensitive neurons become fatigued, so they respond less energetically to all

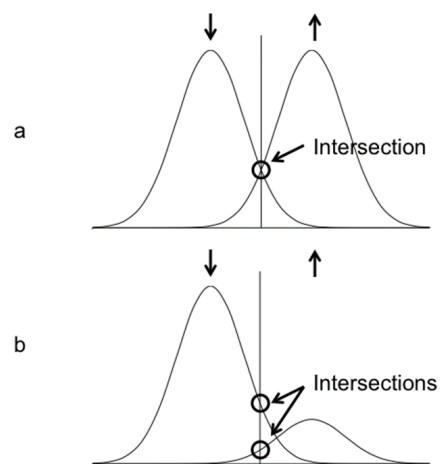


Figure 4. Bell curves depicting the responses of motion-sensitive neurons in early stages of visual processing (Livingstone & Hubel, 1988). The bell curves in Figure 4a represent neurons that respond to downward motion and upward motion respectively. The vertical line represents a non-moving stimulus, which elicits an equal response from both populations of neurons so the overall neural response is balanced. The bell curve on the right in Figure 4b represents the response of motion-sensitive neurons which have become fatigued so they respond less to all speeds. Now the response of downward-sensitive neurons to a non-moving stimulus is greater than the response to upward-sensitive neurons.

speeds (as in Figure 4b) and the visual system is said to have adapted to upward motion. After adaption, the response for non-fatigued downward-sensitive neurons is more vigorous than from the upward-sensitive neurons, and as a result the stationary object appears to drift downward.

The neural response to SFM is more complex than for simple motion. In an SFM globe, the rightward-drifting dots and leftward-drifting dots never appear to collide, so the brain assumes the dots must be positioned at different distances from the observer in order to avoid collisions. This assumption is embodied in four neural populations, each responding to a combination of rotation direction and distance (Bradley, Chang, & Andersen, 1998) rather than the two sets of neurons underlying simple motion aftereffects (i.e., nearby-rightward motion, nearby-leftward motion, distant-rightward motion, and distant-leftward motion). The ambiguity of the globe rests on the fact that the rightward drifting dots could lie on the near surface of the globe and the leftward dots on the far surface, or vice versa. As can be seen in Figure 5, the four populations have interconnections that either encourage (the plus sign) or discourage (the minus sign) activity in other populations. Thus, activity in nearby-

rightward neurons tends to increase the response of distant-leftward neurons; when these two neural populations are simultaneously active, the perceived rotation direction is counterclockwise as seen from above. Under prolonged viewing, these two neural populations become fatigued to the point at which the other two neural populations (distant-rightward and nearby-leftward) suddenly become active, thereby generating an abrupt reversal of the apparent rotational direction. Visually assigning dots to the near or far surface could go either way, but once an assignment is made, the globe appears to the conscious mind to unequivocally rotate in one direction (Bradley et al., 1998).

Visual Adaptation Causes Apparent Reversals

Various kinds of evidence have shown how the neural mechanism underlying the perception of SFM (Bradley et al., 1998) influences the apparent rotational direction. Nawrot and Blake (1993) describe an experiment in which observers viewed an unambiguously spinning SFM for an extended duration. Presumably, the unambiguously spinning globe forced two populations of motion selective neurons to respond continuously under extended viewing conditions. For example, in trials in which the

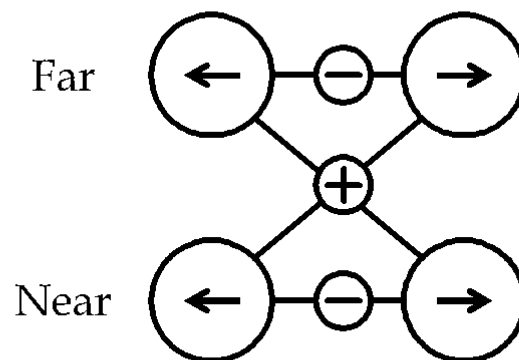


Figure 5. A neural network representing the way early vision responds to SFM (Bradley, Chang, & Anderson, 1998). The four neural populations (far-leftward, far-rightward, near-leftward, and near-rightward) have interconnections that either encourage (the plus sign) or discourage (the minus sign) activity in other neural populations. Under prolonged viewing, two neural populations can become fatigued which allows the other two neural populations to suddenly become active.

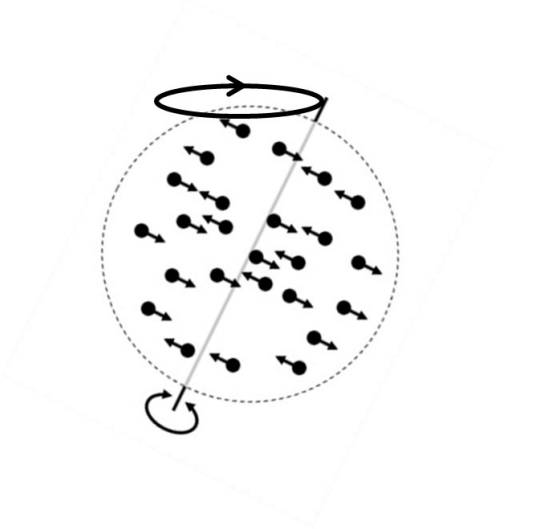


Figure 6. A wobbling SFM globe reduces the rate of reversals.

adapting globe spun counterclockwise, the nearby-rightward neurons and distant-leftward neurons were active throughout the adaptation period. Following adaptation, observers viewed an ambiguously rotating test globe. The test globe appeared to spin in the opposite direction as the adapting globe for most of the time the test globe was visible. Recent work (Pastukhov, Lissner, & Braun, 2014) has shown that a test globe tends to rotate in the opposite direction as the adapting globe, even if the two globes have different shapes.

Neural fatigue is presumed to increase with adaptation duration (Niedeggen & Wist, 1998), almost like filling a pitcher of water from the faucet. Just as a pitcher could be filled faster from a spigot on full blast than from a trickle, neurons should fatigue faster if the stimulus intensity is increased. Brouwer and van Ee (2006) found that increasing the density and velocity of dots that compose ambiguous SFM increases the rate of reversals. The authors hypothesized the more intense physical characteristics led to more reversals because they promoted faster buildup of neural adaptation.

Extending the faucet analogy, a pitcher should take longer to fill if the flow of water were

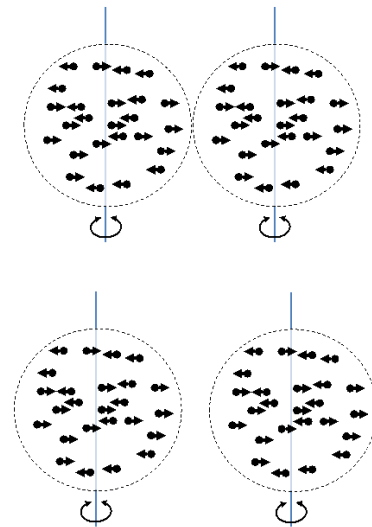


Figure 7. SFM globes with parallel axes that either touch or have a gap between them as in Gilroy and Blake (2004). When the surfaces touch, the globes appear to rotate predominately in opposite directions as if frictionally coupled, but not when a gap appears between the globes.

intermittently interrupted than if the flow were continuous, so intermittent presentation of a stimulus should interfere with the buildup of neural fatigue. Leopold, Wilke, Maier, and Logothetis (2002) presented an ambiguously rotating figure for which the 3-s viewing times were interspersed with 5-s blank intervals. Participants in the discontinuous group experienced far fewer reversals than participants who viewed the globe continuously. This stabilization of dominance increased even further upon greater absence of the stimulus. The same results were recorded when participants intermittently closed and opened their eyes. Although it has been argued that perceptual reversals occur via an 'automatic system' which works independently of the visual stimulus (Pettigrew, 2001), Leopold et al. showed the opposite to be true. Reversals only occurred when the stimulus was visible, implying that the brain would not automatically switch unless the stimulus was accessible. This is consistent with earlier work showing that intermittent stimulus exposure reduces the rate of reversals of the Necker cube (Orbach et al., 1963).

Because the visual field is arranged on the

cortex like a map (Livingstone & Hubel, 1988), each neural pitcher fills up only if the stimulus is presented to the corresponding retinal location. A stimulus that moves around the visual field is like a faucet that moves around an array of pitchers; as one pitcher begins to fill up, the faucet moves to an empty pitcher. Blake, Sobel, and Gilroy (2003) found that when an ambiguous SFM globe continuously moved around the visual field, the reversal rate slowed because the globe moved to “fresh,” or unadapted retinal locations. Reversals were reduced but not eliminated because as the globe slowly drifted around the retina, a sliver of the globe was projected onto fresh retina at each moment with the remainder projected onto adapted retina. The authors also found that making the axis itself wobble (as can be seen in Figure 6) reduced reversals. The rotational motion of the globe around its axis remained constant, but the local motion of the dots changed continuously. Because motion-sensitive neurons respond to motion direction as well as location, a wobbling globe is like a faucet moving to a fresh pitcher before the previous pitcher is filled. The larger the degree of wobble, the fewer the reversals experienced per minute. The constant change in motion when the globes wobbled prevented adaptation to any given direction of motion, thus slowing the reversal rate.

The Role of Context

Not only do SFM globes switch their apparent rotational direction in response to neural fatigue, SFM globes are also influenced by top-down factors such as context. By context, we mean the way an SFM globe fits together with other stimuli. Investigators have looked at how SFM globes fit together with a) other stimuli viewed at the same time, b) stimuli viewed previously, and c) stimuli presented to other senses such as touch. Here we will describe the influence of each kind of context in turn.

Blake and Gilroy (2004) presented two SFM globes with vertical axes next to each other so their surfaces seemed to touch (as in the upper pair of globes in Figure 7). Under extended viewing, participants indicated that the globes appeared to rotate in predominantly opposite directions (e.g., one rotated clockwise and the

other rotated counterclockwise) when the globes touched, but not when there was a gap between the globes (as for the lower pair of globes in Figure 7). Blake and Gilroy argued that participants imposed their understanding of friction onto their interpretations of the globes because if two balls touch each other, the rotation of one ball will frictionally drive the other to rotate in the opposite direction. Two globes with vertical axes next to each other appear to rotate in opposite directions, but what about figures that are coaxial? Grossmann and Dobbins (2003) showed that when pairs of ambiguous figures are coaxial, the figures tend to appear to rotate in the same direction.

Context may also help the brain make sense of visually ambiguous input in terms of temporal context (Klink, van Wezel, & van Ee, 2012). Prior stimulus exposure may bias a perceptual interpretation toward a specific feature, as if a perceptual memory has been formed (Maier, Wilke, Logothetis, & Leopold, 2003), which is sometimes called cognitive priming (Long & Moran, 2007). When a person is briefly exposed to an unambiguous figure (priming pattern), the ambiguous reversible figure (test pattern) shown shortly after will appear to be the same as the unambiguous figure (as if biased toward the prior pattern). Priming can be seen as the opposite of adaptation because the test globe appears to rotate in the same direction as the previously presented unambiguous SFM globe. The key difference is that priming occurs when the (unambiguous) priming globe appears too briefly to fatigue motion-sensitive neurons, and adaptation occurs when the adapting globe is visible for long enough to fatigue motion-sensitive neurons.

Even though the context of an SFM globe can be defined in terms of its relationship with other visual stimuli, this can be extended to other senses such as touch. People are naturally skilled at identifying an object in terms of shape, size, and mass by touch. Blake, Sobel, and James (2004) found that touch strongly influences an observer's interpretation of ambiguous SFM. Participants grasped a rotating globe with both hands while viewing an ambiguous SFM globe. The participants reported seeing the visual globe rotating in the same direction as the tactile globe for significantly longer than half of the time.

Discussion

A visually ambiguous stimulus such as a rotating SFM globe presents a challenge to visual processing. The stimulus is composed of dots that all move independently, but the individual dot motions are all consistent with a single, global (pun intended) object rotating around its axis. The stimulus is consistent with two mutually exclusive interpretations, but the conscious mind is aware of just one interpretation at a time. One of the most intriguing aspects of ambiguous SFM is the fact that the apparent rotational direction periodically reverses, even as the stimulus remains constant. In this paper, we reviewed research showing that both bottom-up and top-down factors influence the apparent rotational direction of ambiguous SFM.

The primary bottom-up factor influencing the apparent rotational direction of ambiguous SFM is presumed to be adaptation of motion-selective neurons that respond to each individual dot's motion direction and relative depth. Extended viewing of an unambiguous rotating SFM globe makes an ambiguous globe appear to rotate in the opposite direction. Raising the speed and brightness of the dots increases the rate of reversals, and intermittent presentation of the stimulus decreases the rate of reversals. The rotational direction of ambiguous SFM is also sensitive to contextual (top-down) factors such as how the SFM globe fits together with other rotation presented visually at the same time and previously. Globes that appear to be frictionally coupled will appear to rotate in opposite directions, and globes that appear to be coaxial will appear to rotate in the same direction. Viewing a globe too briefly to induce adaptation makes a subsequently appearing globe appear to rotate in the same direction. Grasping a globe biases a visually ambiguous SFM to appear to rotate in same direction as the touch globe.

At this point, you might wonder: Why should anyone care about ambiguous SFM? Psychologists often study cognitive and perceptual illusions because they reveal how the underlying mental processing works (Palmer, 1999). For example, when asked "Which is a more common cause of death: shark attack, or being hit by falling airplane parts?", most people will pick shark attacks, even

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though death by falling airplane parts is more common (Plous, 1993). The errors provoked by questions like this show that people don't actually compare the likelihoods of two events, but instead select the event that is easier to imagine, a strategy which is called the availability heuristic (Tversky & Kahneman, 1974). In most cases, the availability heuristic selects the right answer because the more common event is typically easier to imagine. But in this case, the availability heuristic breaks down because the vividness of shark attacks makes them easier to imagine, even though they are less common.

Just as these kinds of questions reveal how decision making in high level cognition works, ambiguous SFM reveals how decision making in the visual system works. This is not to say that visually ambiguous stimuli are particularly common in our visual environment or there are severe consequences for failing to appropriately perceive motion reversals. Like the availability heuristic, visual decision making relies on heuristics that perform well under most normal circumstances, but to see how a machine works sometimes requires breaking it. As we have described here, ambiguous SFM shows that the visual system relies on the interplay between bottom-up and top-down processing to select mental models from among the infinity of possibilities. More generally, ambiguous SFM shows that visual perception is a constructive process that begins with primitive retinal information (in the case of ambiguous SFM, moving spots of light) and builds a coherent model presented to the conscious mind (a globe spinning around its axis). The commonsense belief that the senses provide direct access to the world (Blake & Sekuler, 2005) is mistaken, and ambiguous SFM shows that visual perception actually takes a great deal of effort occurring outside conscious awareness.

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Special Features

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Clockwork Case Study: A Personality Assessment of Alex from A Clockwork Orange

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Abstract—In this analysis of Alex, the main character from Anthony Burgess' (1962) *A Clockwork Orange*, I report a detailed description of the subject's personality in terms of personality traits, regulation and motivation, and cognitive foundations. Numerous research studies support the idea that personality can be determined with a high degree of accuracy, based on a person's use of language and self-reported behavior (e.g., Goldbeck, Robles, & Turner, 2011; Park et al., 2014). Although the subject is a fictional character, the novel is written as a first person narrative, thus providing a sample of written language, self-reported behavior, and insight into Alex's cognitive processing. Alex is as much a product of the social and physical environment in which he lives as our own general population tends to be. However, the unique, subcultural norms that exist in the dystopian society of *A Clockwork Orange* allow deviance to be both accessible and accepted among the society's youth. However, unlike the petty deviance of his peers, Alex's personality, behavior, and psychological processing are dangerously skewed towards more sociopathic tendencies.

Keywords: A Clockwork Orange, literature, personality, analysis

In *A Clockwork Orange*, Burgess (1962) examines whether free will and a lack of psychological intervention is better for the development of normative human growth or if deviance is the price society must pay for complete social and psychological freedom. This novel takes place in a dystopian society that has become desensitized to sexual and physical violence and views deviant behavior as a typical phase all youths go through as they mature. The youth culture in the novel revolves around fighting with other gangs, petty robberies, and rape, which is referred to as "ultra-violence" by the narrator. This gang-like youth culture dominates the unnamed English city in the novel.

Though laws are generally enforced, the goal of the police force and the parole officers is to keep deviants out of serious trouble until they come of age, while the rest of society attempts to ignore the violence going on around them in order to avoid retaliation. However, the generally corrupt government, coupled with the socially lethargic general population, passively allows the deviant behavior to continue and intensify. Though there is evidence in the text to suggest the novel takes place sometime in the distant future, the exact location and time period remains relatively ambiguous, as Burgess intended the political and social setting of this novel to be a reflection of modern societal temperaments.

*Jeffrey Sable served as Faculty Sponsor.

Alex, the subject of this analysis, is a 15-year-old male whose use of language and behavior is pathologically aggressive and hostile in nature. Compared to the general population in which he lives, Alex's personality and behavior is maladaptive and generally not condoned, as evidenced by his frequent altercations with the law and his current status as a parolee (Burgess, 1962). However, as dictated by cultural norms, Alex's behavior is indicative of the subculture of extreme violence typically reported among the youth, thus making his personality common amongst adolescents of the dystopian civilization in which he functions. Regardless of this piece of subcultural information, Alex himself exhibits characteristically sociopathic behavior. His inability or unwillingness to feel remorse for others, his manipulative behavior, and his otherwise callous and unemotional traits are central to the conceptualization of an "unemotional interpersonal style" (Latzman, Lilienfeld, Latzman, & Clark, 2013, p. 191).

Personality Traits

According to the Five Factor Model (FFM; Fiske, 1949), Alex exhibits personality traits associated with low scores in extraversion, agreeableness, and conscientiousness. The factors of agreeableness and extraversion are commonly associated with the degree to which a person engages in helping behavior and a person's ability to be socially adaptable. On the other hand, the factor of conscientiousness refers to a person's motivation to push towards personal growth (Fiske, 1949; McCrae & John, 1992). Consequently, Alex's behavior is typically unfriendly, hostile, and generally lacking in self-discipline, thus placing these personality characteristics on the lower side of the continuum.

Furthermore, self-reports provided by the first-person narrative of *A Clockwork Orange* (Burgess, 1962) suggest Alex takes genuine pleasure in both his direct and indirect aggression towards others, meaning he perceives aggression as a source of personal enjoyment. It is not uncommon for periods of genuine, joyous ecstasy to follow acts of extreme violence; however, even though Alex describes the affective experience in a positive light, he does not view the behavior itself

as a positive thing. That is, he often makes remarks suggesting he knows what the *good* thing to do is but he chooses, and prefers, the bad. He simultaneously states he would not condone a society in which hostile behavior and extreme violence is wholly accepted. Therefore, he lacks the tendency to report his aggressive acts as positive experiences, which, according to Latzman et al. (2013), would typically be associated with people who are high in extraversion.

Additionally, as Alex is generally unconcerned with social desirability, circumstances in which he is uncharacteristically agreeable can be reasonably attributed to self-interested behavior as opposed to pro-social behavior, which taps into separate but similar aspects of agreeableness and an overall willingness to cooperate (Hilbig, Glockner, & Zettler, 2014). Similarly, previous research found a negative correlation between agreeableness and aggressive cognition, thus providing evidence to suggest the factors of agreeableness and conscientiousness can directly predict self-reported aggressive tendencies (Gleason, Jensen-Campbell, & Richardson, 2004). This finding can be explained based on the factor of agreeableness and its association with maintaining positive interpersonal relations that customarily serve as the basis for social groups. In light of this information, Alex's frequent thoughts of hostility would be both predictive and characteristic of extreme low levels of agreeableness. This would also explain Alex's tendency to be untrustworthy, generally in compliant, and extremely un-altruistic.

Alex frequently resorts to hostility in response to unpredictability and is vulnerable to stress and negativity, characteristics typically associated with people who are high in the factor of neuroticism (Fiske, 1949; McCrae & John, 1992). Although Alex's typical activities involve premeditated robberies and other planned delinquent behaviors, he lacks impulse control in the sense that he is willing to take big risks for monetary, though sometimes trivial, payoffs. Alex is also high in the factor of openness, which is more closely associated with an appreciation of art and culture when measured with the NEO-FFM (McCrae & John, 1992).

Cognitive Foundations

Numerous research studies (e.g., Anderson, Carnagey, & Eubanks, 2003; McFarland, 1984) have found evidence to suggest there is a correlation between music preference and both self-reported and observable maladaptive behavior. McFarland (1984) conducted a study in which participants were randomly assigned to one of three conditions in which they listened to either calm music, tense music, or no music. He then measured the effects of exposure to different genres of music using the Thematic Apperception Test (TAT; Murray, 1971). Participants who listened to tense music while completing the TAT tended to write more unpleasant stories, even when the music did not contain any suggestive lyrics (McFarland, 1984). Similarly, in a study conducted by Anderson et al. (2003), individuals who listened to music with violent or negative lyrics not only tended to experience more negative emotions, but in some cases exhibited more instances of observed hostile behavior, thus establishing a link between music preferences and exposure, to some maladaptive behaviors.

Alex is a fanatic of classical music. More specifically, Alex enjoys the tense, heavily orchestrated works of Ludwig Van Beethoven; he also fantasizes, with explicit detail, about engaging in violent behavior while listening to these records (Burgess, 1962). Given the findings of McFarland (1984) on the effects of music on emotion, it would be plausible to assume that Alex's thoughts, and consequently his behavior, could be a reflection or consequence of his musical preferences. However, to some degree, the effect music has on emotion and cognition depends on how the participant perceives it. In this case, Alex is already prone to negative emotions, so the aggressive orchestration of Beethoven's music, for example, can have a priming effect on his thoughts and behavior. Put another way, Alex's music preference may not necessarily be the direct cause of his aggressive thoughts, but it may be increasing the "accessibility of aggressive thoughts and affect" (Anderson et al., 2003, p. 969).

Research studies (e.g., Goldbeck, Robles, & Turner, 2011; Park et al., 2014) examining word use in comparison to behavioral self-reports have determined a link between language and

personality as measured with the FFM. More specifically, Park and colleagues (2014) found a correlation between low extraversion and a tendency to focus on the self in written and spoken language (e.g., *I don't*; *I shouldn't*), which is consistent with Alex's vocabulary throughout the novel. Additionally, individuals who scored low on extraversion tended to show a greater interest in reporting their interactions with *things* as opposed to reporting social interactions with *people*. As suggested by previous research studies (e.g., Anderson et al., 2003; Park et al., 2014), exposure to negative lyrics can cause the accessibility of hostile thoughts and behaviors to become more salient; therefore, it is possible that Alex's use of *Nadsat*, an invented colloquialism consisting of a combination of English and Russian slang vocabulary, could be associated with his violent behavior (Burgess, 1962). In other words, Alex's use of *Nadsat* to narrate his behaviors is not directly causing his aggression; however, based on the previously mentioned research concerning the priming effect of negative song lyrics on behavior, it is possible that the aggressive emphasis of the slang vocabulary may make aggression and hostility more salient when interacting in social situations.

Regulation and Motivation

As demonstrated by previous research (e.g., Hilbig et al., 2014; Ryan & Deci, 2000), although individuals have the tendency to engage in prosocial behavior, they can also become alienated and apathetic due to developmental social conditions that have the potential to affect self-determination. According to self-determination theory (SDT; Ryan & Deci, 2000), specific social environments can be antagonistic to the development of a psychologically healthy person who exhibits positive tendencies. In the case of Alex, the extrinsic rewards of prosocial behavior have undermined the intrinsic motivation to do good things for his own benefit, leading him to believe his good behavior is only profitable when paired with an external reward through a process known as the overjustification effect (Hilbig et al., 2014). Differences in motivation are typically a reflection of the degree to which the desired behavior has been integrated and internalized into

the individual's own sense of self (Ryan & Deci, 2000). Therefore, even if Alex is extrinsically motivated to become a fully functioning member of society in order to avoid prison (Burgess, 1962), he is still just complying with the external regulations of society. A greater sense of personal autonomy, one of the three psychological needs associated with SDT, is necessary in order to reform the self (Ryan & Deci, 2000).

Conclusion

Hostile and aggressive behaviors do not typically constitute normal behaviors within a society and exhibiting high levels of these behaviors often leads to social rejection. In the case of Alex, social rejection takes the form of alienation from his parents and his older peers (Burgess, 1962). This, in turn, can lead to developmental issues including, but not limited to, adjustment problems and other maladaptive behaviors (Gleason et al., 2004). Furthermore, personality traits, particularly the factor of agreeableness, often co-occur with the development of fewer prosocial behaviors and fewer normative socialization processes (Gleason et al., 2004; Latzman et al., 2013). Although Alex's behavior is due in part to a lack of autonomy, the dystopian environment in which he lives, combined with the youth culture's emphasis on violence, comes together to form a comorbid formula for callousness and sociopathic behavior (Latzman et al., 2013).

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Psychologically Speaking

Making Mortality Salient: An Interview with Tom Pyszczynski

**Cassandra Gonzales¹, Steven McKinley², Geoff Streeter³, Tyler Collette¹
and Richard L. Miller¹**

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Nebraska at Kearney³*

Background—Tom Pyszczynski received his B.A. in psychology from the University of Wisconsin – Milwaukee in 1976 and his Ph.D. in social psychology from the University of Kansas in 1980. He currently holds the position of Distinguished Professor at the University of Colorado - Colorado Springs, where he teaches courses in social psychology. Dr. Pyszczynski's research is focused primarily on Terror Management Theory (TMT), which he developed with his colleagues Dr. Jeff Greenberg and Dr. Sheldon Solomon. TMT is concerned with the role of self-esteem and cultural belief systems in providing protection against core human fears, especially the fear of death. Over the years, Professor Pyszczynski and his colleagues have explored the role of terror management processes in a wide range of topics, including self-esteem, self-deception, prejudice, interpersonal relations, altruism, aggression, sexual ambivalence, disgust, depression, anxiety disorders, trauma, unconscious processes, aging, human development, and terrorism. Dr. Pyszczynski's research has been funded by the National Science Foundation since 1989. He has also received a Humboldt Fellowship for collaborative research with psychologists in Germany and several grants from the Dutch government for collaborative research with psychologists in the Netherlands. Dr. Pyszczynski and his colleagues have played a major role in the development of Experimental Existential Psychology, an emerging sub-discipline of social psychology that applies rigorous experimental methods to the study of human confrontation with existential problems such as death, freedom, isolation, and nature.

Miller:

The Journal of Psychological Inquiry publishes undergraduate student research. Additionally, there is a Special Features section that provides a forum for student essays on topical issues and also features, from time-to-time, interviews with distinguished psychologists. We have asked you [Dr. Pyszczynski] for this interview in order to explore your experiences and thoughts on the role of undergraduate research in teaching. The audience the interview is primarily designed for are students and secondarily for faculty. The

three students who will be conducting this interview are Geoffrey Streeter, Cassandra Gonzales, and Steven McKinley. Geoff is a senior at the University of Nebraska at Kearney. He is a member of Psi Chi and the Psychology Club and serves as an undergraduate teaching assistant for Dr. Krista Fritson. Upon graduation, Geoff intends to pursue a Psy.D. at Midwestern University in Glendale, Arizona. Cassandra Gonzales is a junior at Texas A&M University -Kingsville. She is a McNair Scholar and serves as a research assistant. Her goal is to become a family and marriage counselor.

Steven McKinley is a senior at Colorado Mesa University. He is actively involved in NAMI and is a member of Psi Chi. He plans on entering private practice in clinical psychology after completing graduate school. In addition to these three students, Tyler Collette, who has completed his degree in Anthropology at the University of Texas, San Antonio and is now enrolled in the master's degree program at Texas A&M University-Kingsville, will assist with editing the interview and will be asking questions from the audience. So without further ado, I will leave you in the capable hands of these students, who have prepared a series of questions. The audience is also invited to participate in asking questions of Dr. Pyszczynski.

Note: Several audience members asked questions during this interview. Among them were Dr. Susan Becker, Professor at Colorado Mesa University, who was Dr. Pyszczynski's first graduate student; and Dr. Domenech Rodríguez, the current editor of the Psi Chi Journal of Research. Several students also contributed questions including Stephanie Buckholz, College of Western Idaho; Kirsten Jassak, University of Colorado; and Austin Hernandez, Snow College.

McKinley:

In your talk, you said you were thinking of becoming a priest, and obviously you chose a different path as a psychologist. What was the reaction of your friends and family when you decided to become a psychologist instead of a priest?

Pyszczynski:

At first, they thought it was good that I was going to college, as I was the first person in my family to do so. They had kind of given up on me becoming a priest by then due to my adolescence and the things that I had wanted to do. So they were happy at first, and then when I got out of grad school and couldn't find a job, my dad said, "I told you so." and "Why don't you do something



realistic? There must be some business that needs you." It took me six years to find a tenure track job. I had four visiting assistant professor positions, and by the third, my father said, "Tom, come on, you are our immortality project. Don't fail us." Of course, he didn't really say it that way, but that's what he meant. And finally, I found a job in Colorado. I love to ski, so it was great. Susan Becker was there waiting to be a grad student. What more could I ask for?

Streeter:

Who influenced you to become a psychologist, and who were the significant teachers in your life?

Pyszczynski:

The person who taught my intro class was Alan Baron at the University of Wisconsin in Milwaukee. He was a behaviorist, and he really inspired me to think about human behavior in a scientific way. I really liked behaviorist ideas. Then, what really turned me around was a social psychology class I had with Marshall Dermer. It struck me that this was the way I like to think, and we did a study together when I was an undergrad. After I left, he became a behaviorist, and we would have arguments about that while I

was in grad school. Those two people were especially influential, and of course my graduate school mentor, Jack Brehm, was very important in that he had a very unique style. Jack developed the theory of reactance, which is basically the idea that if you do something that threatens a person's freedom of choice it encourages the person to react in the opposite way. When he retired, I told this story because it's true. Towards the end of grad school, I was sitting around in the student center looking pretty glum. He came over and sat down next to me and said, "I heard what happened." My girlfriend had just dumped me, and I had been with her about 5 or 6 years by then. He said, "You know, you have got to ask yourself, 'Do you want to get her back?'" I said, "As horrible as this is, I do." He said, "Well, then all you can do is absolutely nothing. This is my advice. Do nothing to encourage her to come back. Do nothing to undermine her attempt to do whatever it is she's trying to do." I did the best I could with that, and I've never forgiven Jack because we're still married. And, I've always held that against him. Other influences include, Larry Wrightsman and Bill Bowerman, who were other great social psychologists out of Kansas, and Bob Wicklund, who was one of Jack Brehm's earlier grad students from when he taught at Duke.

Collette:

Why did you decide to become a professor?

Pyszczynski:

Well, there's not much else you can do with a social psychology Ph.D. Just kidding. No, I guess about the time I was a senior I was checking the professors out and thinking, "That's really cool. What they're doing just seems like a great way to make a living. Basically, talking about interesting ideas, and your job is to come up with more interesting ideas." I thought psychology was especially great because it is the most interesting, well not to everyone but to me the most interesting, thing there is. And, it

still is a field where there is so much more to know. I really just thought that the idea of making a living trying to figure out how things work and talking to students couldn't be better. Most days, I still think that.

McKinley:

Let's move on to questions dealing with research. Obviously, you're very involved with research and scholarship. What motivated you to get involved with the scholarship and research aspect?

Pyszczynski:

I guess going back to Marshall Dorners' class when I heard about these social psychology experiments, I thought they were all these kinds of ingenious and clever experiments. I was especially influenced by the cognitive dissonance research, where you would try to get people to do things they didn't want to do and look at how they would react to it. They had all these elaborate scenarios. That just always seemed like it was really intriguing and fun. One of my favorite little research tools we came up with, that other people use sometimes, is a way of measuring aggression by putting people in situations where they think they are in a study of taste preferences, and your job is to keep the participant blind and measure out food (and you measure out hot sauce). The other person, that's a confederate, says, "Oh, that really hurts my stomach; I don't want much of that." Usually, they would just give the subjects a little bit. But if they are reminded of death and the other person is of the other political persuasion than themselves, they fill it to the top. Those kind of things always just grab me.

Collette:

You've been studying Terror Management Theory for a long time. Did you have any previous research interests before that?

Pyszczynski:

I started out being interested in love. That's

what I studied when I was an undergraduate and moving on towards grad school. I did some work on self-esteem and how people manage to make excuses and believe them; work showing how we control the information we take in that supports the delusions we want to have about ourselves and also a lot of work on depression.

Miller:

Did your move from love to death have anything to do with your break up with your girlfriend? Sorry.

Pyszczynski:

It was a delayed reaction. No, it had more to do with getting back together. We started on this around the time we got married. We started on this in 83-84. We got married in 85. Maybe that's what made us get married finally after 14 years.

Gonzales:

How, if at all, have you involved undergrad students in your research?

Pyszczynski:

We've always had undergrad students working with us in a couple of different ways. We have a pretty active honors program where we do sort of intensive mentoring. Our honors thesis program is designed to be like a master's program. I always try to work with some honors students. I've worked with undergrads who have done studies that they deserve to be, and were, first author on. A lot of times undergraduates start off coming in and helping graduate students with their studies and as additional experimenters. It's really, really important. I think one of the reasons I ended up in social psychology was because Marshal Dermer asked me to do a study with him. He said, "You seem like a smart kid. Why don't you come and work with me?" He had just got out of grad school and was looking for help. I think that's really important.

Streeter:

What led you to Terror Management Theory? I know you touched on this in your presentation, but how did you originally get hooked up with Solomon and Greenburg?

Pyszczynski:

I met Sheldon in grad school. He got to Kansas a year before I did and had a grad student office. He was this guy who was always sleeping on a beanbag when I was there. We talked a little bit and then I got to know him at a jazz concert in the park. I was at the concert. I turned to reach for my cooler, and he was sitting there so we started talking. Jeff showed up the next year, and we all shared an office together and ended up becoming friends. We did one study together while we were in grad school and just kept in touch. We loved to travel, so we would go to conferences together, which was important. Jeff and I were doing studies together and connected our research initially. Sheldon was a little ahead of us, but showed us Ernst Becker's book, *The Denial of Death*, and got us to read it. So after reading it, I was the last convert because I was thinking this could be a career-ender. It seemed like it because it wasn't going anywhere, but I thought, "What the hell?"

Streeter:

How has TMT changed over time?

Pyszczynski:

Good question. The core of it really hasn't changed much, but I think we have gotten a lot clearer on how it works. We've become a lot more precise in our language and figured out how some of those unconscious processes work. Actually, that brings us to Susan Becker, my first graduate student. When I showed up in Colorado, we were doing these studies about death and they never worked, but Jeff was doing studies in Arizona that always worked. We thought, among other possibilities, maybe these people in Colorado Springs are different. Then it dawned on us that we should look at

our materials. It turned out that we were using the same materials, but putting them in a different order. What Jeff was doing in the initial studies was to give people a death reminder, followed by a mood measure using the multiple affect checklist, and then he exposed them to some of the threats to their cultural worldview. Being a lot smarter than Jeff, I thought we should remind subjects of death and then measure their reaction right away and measure their mood later. Around that time, a German psychologist wrote us saying he couldn't replicate our results. We looked at his study and saw he was doing a very long, drawn out death imagination thing. So, we told him to try out our materials. Then it dawned on us that a little death reminder is much more potent than a big one, which isn't the way dose-response curves usually go. It's usually more treatment results in more effect. We also realized that you need to distract people after reminding them of death, which led us to figure out the thoughts of death have the effects we are talking about when they are out of consciousness, on the fringes of awareness. This is why we can't really introspect on this, and some people think, "Well that can't be." So, we eventually figured out that immediately after we remind people of death, what people do is think about how they can stay alive, getting healthy (quitting smoking, losing weight, eating healthy). They then promise to do all that but forget about it and don't do it. Then about 10 minutes later is when you see the increase in clinging to the worldview.

Becker:

What our study was doing initially was hitting them over the head with death.

Pyszczynski:

Yeah, each time the study didn't work, we tried to make the manipulation stronger. When in fact, we should have made it weaker.

Gonzales:

I know you spoke about this in your presentation, but for anyone who wasn't here, how can TMT help us understand terrorism?

Pyszczynski:

The basic idea is that terrorism results from a lot of things, and most people think about the concrete grievances that people who resort to terrorism have. But, the concrete and psychological blend together a lot. Terrorists tend to be people who aren't getting their basic needs met. They tend to be reacting to what they see as unfair treatment or violations of what they value or hold sacred. Bin Laden talked about three things: American military bases in Saudi Arabia, the history of Americans using the Middle East for oil and not caring about the Arab people, and American support of Israel. These are the concrete grievances that threaten our worldviews, and by challenging these worldviews, it increases the existential force that is responded to by zealotry to fight the evil. The same thing happens on our side.

Buckholz:

Have you done a study that has looked at how our media (Facebook or media in general) have impacted our view of terrorism across the country, since it's usually opinion, but is often taken for fact?

Pyszczynski:

Someone did a study where the death reminder was just a little thing on the top of the screen announcing Michigan State's Day of the Dead Celebration. People who got that version were more supportive of their worldview. How the media affects us is really complicated. Every time you go to the news page on your browser, you're told about people dying in a war somewhere. We think what that temporarily does is activate the fear. It also happens when you call your mom, and she tells you who in the family has died recently or who has been diagnosed with something terrible. The idea is that death is everywhere you go. We're not

consciously aware of it, but you're driving in traffic and a hearse drives by. We've studied what happens when that occurs. Sort of like the idea that death is your address. You know it, but you're not thinking about it. But at the same time, you're reminded of it constantly and just brush it off. We think that is one of the things that keeps us going. The thing is that death is a fact of life, so I don't want to blame the hearse that drove by. It's just a reminder.

Streeter:

Out of all the research you have done, what led you to go do research in Germany and Holland?

Pyszczynski:

I like to travel. In all honesty, I really love traveling. I met psychologists from those countries, and we started talking about collaborating. [Here is] one cool story. There was an undergrad student at University of Nijmegen in the Netherlands, Mark Dechesme. The head of his department wanted to bring the culture and religion wing of the social psychology program together. He was nearing retirement, and he saw this terror management thing. So, he asked for an undergraduate volunteer from his university to come to the United States and infiltrate (take classes with Dr. Tom). So, he did and did some really interesting studies. I went over to the Netherlands to collaborate with him after he became a professor. He is still a professor, but he does a lot of work with terrorism and a lot of consulting with agencies in Pakistan and places like that. So on the personal side, I love traveling and meeting people. On the professional side, it's really important to do studies in other places. For example, I will be teaching a terror management class in Italy this summer, which I think I'll be able to suffer through.

Miller:

What do you expect happens when individuals are exposed to death all the time,

like in a warzone?

Pyszczynski:

Good question. On the one hand, I think that promotes their commitment to their belief system and encourages zealotry. It encourages people to believe in whatever cause or worldview they already have. There was a study, done a number of years ago, by Emanuele Castano, an Italian psychologist, which looked at crematory workers in Varanasi, India on the Ganges River. That is a scared place for Hindus, like a city of death. There are many crematoria, and they do these outdoors cremations. Each place probably cremates 100 bodies a day and then dumps the ashes in the river. Castano did a study of these workers, and what he found was these workers didn't show any responses to reminders of death. They were kind of living death. On the other hand, without the death reminders, they were more prejudiced than people in neighboring villages. The idea was that this chronic exposure to death made them more prejudiced and also less affected by momentary reminders, as if they're chronically mortality salient. This notion actually brings up a question my Iranian friend asked me, which was: I've been studying terror management for 15 years, and students in my class think it's interesting, but wrong because what most of them [the students] say is they [the terrorists] hope they die today. They [the students] say they [the terrorists] want it to happen faster. One of the things he said [my Iranian friend] is that death is probably different in Iran than in your country. For example, in Iran, it is fairly common on the weekends for people to get out the burial shroud they are going to be buried in and sit with it and think and pray. There is another old custom, still practiced by old men on Fridays, which is a holy day. They will go to their graves, which are already dug out, and crawl down in them and pray. He says Iran is more into death. I asked him to try some studies. Six months later, he wrote back and

said, "I have done five experiments and they all replicate." So, we start collaborating, and after this collaboration, I was worried about his well-being because of the study we did about suicide bombers. But after the study was published, he had five job offers from Iranian universities. Also, a member of the Revolutionary Guard visited him and brought him in front of a counsel of religious leaders to discuss and question him about what he was doing. At this point, his wife wrote me and asked me to help them get out of Iran. We connected him with a group called Scholars at Risk, and he and his family went on a research visit to Limerick University in Ireland to teach there for a semester and never went back. He later went to NYU for a semester and then down to El Paso, which is where he is living now.

McKinley:

Are there any societies or societal beliefs that act as a buffer against prejudice or against death?

Pyszczynski:

First of all, all cultural beliefs try to do that and are effective to some extent. We've recently been doing studies with Buddhist Monks in Korea, and so far we haven't found a mortality salience effect in Buddhists. We remind them of death and compare them to non-Buddhist Koreans, and they're not affected. We also look at how much they meditate each day. Some meditate an hour a day, but some meditate nine hours a day. What we find is that the more they meditate, the less committed to their Korean worldview they are [and] also less worried about North Korea. However, what we haven't done yet is conduct a study to see how they react to someone who insults Buddhism. Buddhism is really about compassion and acceptance. So, one possibility is that you're reminded of death and become more negative to a person who insults Buddhism. Another possibility is those values really come through and affect them. You remind them of death, and they

become more accepting and passionate towards someone who insults Buddhism. That would show that they are using that [meditation] to deal with death. The third possibility is that they just don't respond and that is what we are trying to find out. We've also done a study looking at the effect of the meditation training these monks do for businesses in Korea, and we found that after a 30-minute meditation session, people don't show mortality salience effects, even though they would have shown them before meditation. That is a short-term effect. The idea is that there is both an immediate short-term effect of meditation mindfulness and also a long-term more chronic effect. The message one gets from meditation is to observe things without evaluating and judging. Our hunch is that meditating once will have an effect on the person for a couple of hours, but these people who meditate every day for most of their day are very transformed. So that is one worldview. What we tend to find is that people in other cultures deal with death in different ways.

Jassak:

Have you found that college-age students have a differing opinion about factors of death or just death reminders than other age groups have?

Pyszczynski:

Most of our research is done with college students, but at my university, University of Colorado, Colorado Springs, traditionally we've had a very diverse age range. Usually, participants in our studies are in the age range of 18-55. Recently, we've been studying older people, 65 and above, and what we've been finding is that older people deal with thoughts of death differently. First of all, they say they are less afraid of death, and if you look at a general group of older people, reminding them of death doesn't make them more negative towards people who are different. If anything, it makes them more positive. Our idea is that as we go through life we gradually work it out and

change the way we deal with death. One of the things about getting old is that as you age, not only are you closer to death, but you are reminded of it more often because you have more aches and pains, more of your friends are dying, doctors want more and more tests, and you know that life only lasts so long.

Becker:

You're no longer someone's child.

Pyszczynski:

Yeah, and your child is now having children, and that's a little scary. In addition, your self-esteem takes hits because a lot of what you used to base it on you aren't as good at anymore—whether it be your appearance, athletic ability, or bass playing. There are a lot of things you used to get self-esteem from, but you can't get as much anymore. Your kids, younger people, and your students view your worldview as quaint old-time thinking. They kind of think, "Well those are interesting values and beliefs. That's kind of cute." Also, a lot of your social network is gone, either they have died or moved away. So the idea is that as you age, you would think you know that life ends. The oldest person in the world was 112, and she was oldest for like a week, and then she died. Now the average life expectancy for women is late 70s - early 80s. So you think knowing all that stuff would turn old people into the most bitter, angry, depressed people around. However, we think that those exact things promote a developmental shift towards other basic ways of coping with death. We also know that older people become more religious when they age, that drops overtime in mid-life then goes back up. We think the most important thing is there is a general transition in how you deal with life and death, and what we found recently is that it's older people who are high in cognitive functioning, especially executive functioning, who react to death differently. Older adults who are low in executive functioning look just like people your age (college students).

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Older adults tend to respond to death reminders by becoming more accepting of people who are different and more committed to the welfare of others than of themselves.

Gonzales:

Did your early undergraduate experiences shape the way you work with undergraduate students now?

Pyszczynski:

Yeah it did. Actually, I think my graduate experience affected it more. One of the things I picked up from Jack Brehm, my mentor in graduate school, was his teaching style, because he was a believer in minimizing reactance and maximizing freedom. His idea was that this would encourage creative thinking. His idea, then, was to intervene as little as possible, which is hard. My first class with him started like this (arms crossed, silent, looking at his students, shifting here and there and murmuring hmm here and there). Then, after about 15 minutes, he said, "Well unless you are going to say anything, you can just go because I'm not here to tell you anything." That is my ideal, but I realize that won't work in a lecture class. But yeah, he was a really big influence.

Gonzales:

Did that shape the way you deal with undergraduate students now?

Pyszczynski:

Yeah, over the years I've realized that graduate and undergraduate students have to be talked to and mentored a little bit differently. But, I still really try and encourage people to generate their own ideas and try to give people space to think and then talk about their thoughts, rather than trying to ram as much information into them as I can. I think that is really helpful because there is a lot of knowledge about people to be learned in psychology. One of the things we are hoping to do as people go

through their education is to help them learn how to think a little bit better. That is also something that I've actually been thinking about; the explicit strategies, like how to encourage people to think for themselves. One of the things I do in research methods is try to get students to come up with an idea. Then I use that idea as the content, the vehicle to talk about the core concepts in the class like experimental design and the difference between correlational studies and experimental studies. I try to get them to think that through using their own ideas, which should be more interesting to them than using other people's studies as examples. We'll see how that works. It's kind of a new thing I've been doing.

Streeter:

Has your teaching style evolved from the time you started until now?

Pyszczynski:

I don't use notes anymore. I've started to have my students put nametags on their desks. I was never good with names. And as I've gotten older, it just seems stereotypic, and it's embarrassing. Also, for those of you who have been teaching for a while, after 30 some years, you have taught a lot of students, and they kind of start to blend together a little bit. So, the nametag idea I like. Of course in a lecture class, it doesn't matter. When you only have a dozen or 20 people, it's kind of embarrassing to keep saying, "Judy...? Janie...? Janet...? Who are you?" So, the nametags help. I like to think I take it seriously and try to think about what I can do to make it better. I try not to be disturbed when they don't like me, which is hard because that is a hard thing to take as a teacher. I don't understand this, but I find when I think I'm doing a good job I'm really the least popular. Then when I feel like they hate the material, they are really the fondest of the class.

Streeter:

What is your favorite part about working

with undergraduate students?

Pyszczynski:

I really like it when I find someone who is really bright and good at thinking about these things and kind of discovering it. It's also kind of neat when they don't know it yet. It's like they are full of energy, ideas and enthusiasm, but they don't really realize they've got it. It is really nice and rewarding to help them realize that. You know on the other side of that, if you have a student who is not getting it or having a hard time and you can use the ideas we talk about in psychology to help them understand themselves a little bit better, which is also good.

Buckholz:

You said your Iranian friend talked about people in other countries who think a lot about death, understand they are going to die, and celebrate it. Have you done studies where you present their death, provide reminders, and see how they respond to it?

Pyszczynski:

No, that would be a great idea though. Doing studies in Iran is not easy, especially since my collaborator has left the building, so to speak. Actually, I just got an email from a young guy in southern Iran. He is a Kurd, and it kind of broke my heart. He wrote and said, "I want to study what makes people want to join Isis. I do this because I'm a Kurd, and many of us are not really valued in Iran or the Middle East. Isis doesn't like the Kurds either, but some Kurds still want to join and fight with them." He said, "Of my high school friends, only me and one other guy haven't joined Isis. Three of them are dead now, and the rest say they don't intend to come back alive." On the one hand, this is a unique opportunity to study these guys, but I thought about it and said, "You know, I would love to do that, but just think about what is going to happen if you go handing out questionnaires with death reminders to people in Toyota vans with machine guns." I

told him to just think about your family. He is a graduate student in psychology as well as political science and has been reading and thinking about the work we have been doing. They want to continue it with Isis people. I just thought it was too dangerous. I asked my buddy from Iran, who now lives here in the U.S., and he said, "No. Tell that guy a fellow Iranian said don't do it."

Buckholz:

I'd be curious to see those people who come to America from Iran and see how their viewpoint changes. I have friends that came here 3 years ago and friends that came 20 years ago, and they still stick to the old ways.

Pyszczyński:

One of the things Abdul told me is that, contrary to what we think, most Iranians really like Americans. If they met you, they'd love to talk to you, even these radicals. If you talk to them, they admire a lot of our movies and music and things. Abdul came to the United States for a terrorism conference in Austin TX, and one of his missions was to bring back a pair of cowboy boots for his wife. Another thing, which is kind of funny, is we went to go grab some food, and we went to 6th street where there are a lot of college girls who dress much differently than any girls in Iran. His first comment was, "These girls are going to get raped aren't they, and this is terrible." I said, "No, it's just Saturday night." Then he asked if they're all prostitutes. I again had to tell him, "No, they are just college women out partying." Later, he asked, "Okay, what do I do with my eyes?" I told him he can sneak a quick peak, but don't stare. The main point, he said things are a lot more similar. He said women will go out in public with their faces and heads covered, and then when they get in the house, they would take it off and be wearing blue jeans and normal clothes. This isn't everyone. Obviously, there are other people who take it more seriously. He said his view was that about 30-40% of Iranians support the hardcore regime, maybe 35-40% don't,

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and the rest don't pay attention. The ones who don't pay attention don't really care; they just want to live their lives. His main point is that the vast majority of people there just want to live and really aren't that into these political things. He was also really convinced that, when they had that second election of Ahmadinejad, he said there is no way he won. He was really excited about the green movement and the protest. After that was shut down, he just thought things were going to get a lot worse and that is when he decided he really needed to leave.

Rodríguez:

I think most related to the current string of discussion, you use deception in your research, you work internationally, and the interaction of international work and deception, I think, would be very tricky, especially as it relates to IRBs and negotiating. I was wondering if that changed over time and maybe some advice for researchers who do international work that use deception in sensitive areas.

Pyszczyński:

Yeah, it has [changed]. One of the things is that most of our studies are deception by omission. In other words, usually what we tell people is we are doing a study of the relationship between personality and attitudes toward social issues; and you are going to answer a variety of questions about your attitudes, your personality features, and your feelings about certain things. Now, that's correct. We don't tell them we are interested in how death reminders affect them. That would just make the study unable to tell us anything. We typically rely on people's own IRBs to do things, although recently we have been more conscious that our IRB wants to approve it as well. I think it's an interesting thing that an IRB in Colorado is going to approve what someone does in France or Israel. In Iran, my contact and I would have a few emails back and forth, and they didn't have an IRB. So, he would talk to his department head and a few

other people, and that's the way they do things there. It's more of an informal process of discussing the ethics of it. You know Israel, France, Germany, and most of the other places I did my collaboration now have their own IRBs or formal boards that do that. It's an interesting issue. I have a lot of thoughts on IRBs. I was on one for 13 years and just the idea that American universities should be evaluating studies that are led by people from other universities; I have a problem with that.

Rodríguez:

Any recommendations for people doing international research? Would you leave it completely in the hands of researchers elsewhere to determine if they have to seek approval or not? Do you ask those questions?

Pyszczynski:

It depends. I think that is a personal decision. I think ethical decisions ought to be a personal decision, but I think there should be some oversight. I think that ethical issues and decisions really land primarily with the researcher, but I realize that is not how the regulations are interpreted right now in many places. I think in the next year the Department of Health and Human Services is going to come out with some revised ideas that are currently being discussed. I think that IRBs are losing the sight of the ethical mission and becoming more focused on avoiding lawsuits. And I mean, isn't that sad? I just think that ethics is something that should be the primary focus, the welfare of the research participants, rather than if the format of your consent form is right and whether the pagination and indentations are in the right place. And, I just think that is what some IRBs are more interested in. I was on a committee that created the guidelines for the IRB about 15 years ago, and I was on the IRB for about 14 years. Over time, it gradually moved away from the question of ethics to the discussion of, literally, punctuation and outrage for using

last year's consent form. I think that's just sad because I think ethics are extremely important.

Buckholz:

What are the challenges doing international research in collaboration with researchers who are from a different country?

Pyszczynski:

On international collaborations, I think it's really important to have a sophisticated person from that other place who understands the psychology of it and understands the culture. You know, we could do these studies, and these studies would be silly if we didn't know their culture and didn't know how these things we present in our experiments are taken by the participants. I think that unless we incorporate someone from the other side we won't know what questions to ask or how to do it in the right way, and I'm really fascinated by that. Getting input from people of the culture that you're trying to understand so that you know you're asking the correct questions. And from an IRB perspective, doing the study in a way that is not going to be insulting or harmful to people in the other culture. So, the advice is having a good relationship with your collaborator who knows the people so that you can scientifically and ethically do the right thing.

Gonzales:

What publications are currently in the works?

Pyszczynski:

Well, we just finished a book, "The Worm at the Core," and it's going to be introducing the ideas in a very accessible way that is aimed at an educated layperson. I hope it's also interesting to psychologists too. It talks about how death affects people, how it affected history, how it affects medicine, how it affects our ideas about sexuality, and all these different aspects of life. I also just

finished a paper called, 30 Years of Theory Management Theory. It's for *Advances in Experimental Social Psychology*, which is an edited volume. It's pretty important and an influential source of information in our field. It's where our first major TMT paper was published. This new paper is kind of a looking forward, looking back piece. It talks about how different conceptual modules have kind of developed around the core theory. We're really interested in what people might be able to do to get around, to sort of transcend death, and get over the fear of death. As a first step toward understanding what might be better ways of dealing with death, we studied Buddhists, older people, and some people who worked in hospices. We're also looking to see how the TMT ideas relate to environmental issues and concerns about the climate. We did studies in France that showed that among French conservatives showing pictures of the Fukushima meltdown makes them actually want more nuclear power plants. That kind of fits the way some Americans have reacted to social issues. We're also trying to, empirically, get to the question on why death is so upsetting. The main controversy in this realm is whether death is frightening because you're not going to live, or is death frightening because you're not certain about when and how it will happen or what happens afterwards, or is it that death is frightening because it takes your meaning system away. We think that's part of it, but we think certainty about your meaning system is protection from death, rather than death being a threat to your certainty. And, the question I've never heard the answer to is what if you were certain about when and where you will die and what happens afterwards? What if you knew you were going to die tomorrow at 11:13 a.m.? You knew it was going to be painful (maybe being hit by a car on so and so street). You knew how your body was going to be handled afterwards, and you knew that there was for sure no afterlife and that your family was going to be devastated but that in

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a couple of years they would stop thinking about you. Would that make you feel better than being uncertain about death? I don't think so.

Streeter:

What are your future plans for scholarship and teaching?

Pyszczynski:

Just doing the same thing until I either retire or die [he said with a chuckle]. I just turned 60, and I just started to think about what to actually do later. But for now, just keep going.

McKinley:

You have a lot of research and have published a lot of work. How do you balance your personal and work life?

Pyszczynski:

I used to really feel like it was a balance, but this has kind of been a tricky year. A lot of things have all come together at one time, and it's been a hard balance. I think that I've always felt that I work to live rather than the other way around, and I try to have special time with my wife and family. I like to make time to ski and go hiking. I feel like a recipe for not doing good work is working all the time. I feel like if you're one of those academics who is at your office late Sunday night, I feel that that's going to interfere with your creativity and output. However, I do find myself at my office working late more than I'd like to just because things pile up. But, I'm trying to figure that out.

Collette:

Aside from the skiing, hiking, and music, do you have any other hobbies?

Pyszczynski:

I really like to cook, and I'm currently trying to learn to cook in a healthier way. I really do enjoy that. Music is also really important to me. I like reading and watching movies, and I'm a really big fan of hiking and

traveling. Those are the big ones.

Collette:

What is your favorite dish to make?

Pyszczyński:

I don't have one because I really like to try different things. I like to fuse things together.

Becker:

Whatever happened to Freddy and the Fish sticks?

Pyszczyński:

Freddy and the Fish Sticks was a band that we had at UCCS when I first got there, with Fred Coolidge, Jim Hamilton, and other professors. We kind of split. Jim took a job elsewhere so his wife could also get a faculty position. The band kind of fell apart. However, I met up with some other folks and got into a reggae band that I did for about 20 years. What was kind of cool was we used to play around in the late 80's early 90's. One of the highlights was we played a place in Aspen where they had the band of the night at the top of the marquee. So they had our name, Cool Runnings, and right beneath us they had Jimmy Buffet. It looked like he was our opening act. I still have that picture. So, we split in the early 90's, and then about 15 years later, I had a party just to get the guys together. We thought, "Well we have some instruments," and we played. We decided, "Let's do it again," and so we did about another 8 years. Then that kind of fell apart. Playing clubs is just no good for people in their 50's and especially not for those in their 60's. Kind of fun, but things kind of fell apart.

Hernandez:

When you played in the reggae band, what were your influences?

Pyszczyński:

Well of course Bob Marley for starters. We also did a lot of Burning Spear, Culture, and Steel Pulse. We didn't want to just do Bob

Marley's greatest hits, so we also started writing our own stuff. Then we also all did a jam band because we wanted to have that improvised edge to it. I always wanted to be a rock and roll star. That's the only other cool job.

Miller:

On that note of encouragement to all future rock stars, I see that our time has come to an end. Thank you so much for talking with us.

Journal of Psychological Inquiry

Call for Papers

The *Journal of Psychological Inquiry* (JPI) encourages undergraduate students to submit manuscripts for consideration. Manuscripts may include:

- *Empirical studies*
- *Literature reviews*
- *Historical articles*
- *Special Features I: Evaluating controversial issues*. Two students work together on different facets of the same issue.
 - Select a controversial issue relevant to an area of psychology (e.g., Does violence on television have harmful effects on children?—developmental psychology; Is homosexuality incompatible with the military?—human sexuality; Are repressed memories real?—cognitive psychology). Each student addresses the current empirical research and makes a persuasive case for one side of the argument.
- *Special Features II: Conducting psychological analyses- Dramatic*. This manuscript is a psychological analysis of a television program or movie.
 - Television program: select an episode from a popular, 30-60 min television program, describe the salient behaviors, activities, and/or interactions, and interpret that scene using psychological concepts and principles. The presentation should identify the title of the program and the name of the television network. Describe the episode and paraphrase the dialogue. Finally, interpret behavior using appropriate concepts and/or principles that refer to the research literature.
 - Analyze a feature film for psychological content. Discuss the major themes but try to concentrate on applying some of the more obscure psychological terms, theories, or concepts. Briefly describe the plot and then select key scenes that illustrate one or more psychological principles. Describe how the principle is illustrated in the movie and provide a critical analysis of the illustration that refers to the research literature.
- *Special Features III: Conducting psychological analyses- Current events*. By using the perspective of any content area in psychology, this manuscript analyzes a current event.
 - Example 1: Several psychological theories could be used to describe people's reactions to the destruction of the World Trade Center on September 11, 2001. Terror management research has often shown that after reminders of mortality people show greater investment in and support for groups to which they belong and tend to derogate groups that threaten their worldview (Harmon-Hones, Greenberg, Solomon, & Simon, 1996). Several studies have shown the link between mortality salience and nationalistic bias (see Greenberg, Simon, Pyszczynski, & Solomon, 1992). Consistent with these findings, the news reported that prejudice towards African Americans decreased noticeably after 9/11 as citizens began to see all Americans as more similar than different.

- Example 2: A psychological concept that could be applied to the events of September 11 would be that of bounded rationality, which is the tendency to think unclearly about environmental hazards prior to their occurrence (Slovic, Kunreuther, & White, 1974). Work in environmental psychology would help explain why we were so surprised by his terrorist act.
- *Special Features IV: Teaching techniques*- Student and faculty mentor collaborate on this manuscript regarding a teaching technique the faculty member uses that the student found particularly helpful.
 - Some examples of teaching techniques are interteaching, the use of clickers, podcasting, team-based learning, and reflective journaling. The description should contain enough information so that another teacher could use the technique and should provide reasons why you think the technique worked well. The second half of the paper should be written by the faculty member who can explain why he or she chose the technique you found to be effective, and what they hoped to accomplish in terms of learning outcomes by using the technique.

Manuscripts may cover any topical area in the psychological science. Further details for the special features submission can be found at the end of volume 18 (1), available at: <http://www.fhsu.edu/psych/jpi/>

Submission Details:

1. Manuscripts must have an undergraduate as the primary author. Manuscripts by graduates will be accepted if the work was completed as an undergraduate. Graduate students or faculty may be co-authors, if their role was one of teacher or mentor versus equal collaborator.
2. Manuscripts must come from students who meet the following conditions: (a) from students at institutions who are current on their financial annual support of JPI (see list on JPI website), (b) from students at institutions who are willing to pay an \$80 annual processing fee for unlimited submissions, or (c) from students who pay a one-time \$30 processing fee to have a single submission processed.
3. Submit original manuscripts only. Do not submit manuscripts that have been accepted for publication or that have been published elsewhere.
4. All manuscripts should be formatted in accordance with the APA manual (latest edition).
5. Submissions are made online at <http://www.edmgr.com/jpi>.
6. Ordinarily, the review process will be completed in 30 to 60 days.
7. If a manuscript requires revisions, the author(s) is (are) responsible for making the necessary changes and resubmitting the manuscript to the Journal. Sometimes you may have to revise manuscripts more than once.
8. For further submission guidelines, see the JPI website at <http://www.fhsu.edu/psych/jpi/> or contact Dr. Jenn Bonds-Raacke (jmbondsraacke@fhsu.edu) or Dr. John Raacke (jdraacke@fhsu.edu).