2020

Volume 24, Number 2, Fall
Issn 1085-6641

Journal of Psychological Inquiry

Journal of Psychological Inquiry
Editorial Board

Journal of
Psychological Inquiry

Volume 24 Number 2 2020

Journal Contents

Articles

From the Editor's Desk

We made it. I think.

Before the year began, many of us were superstitiously optimistic about what to expect, hoping the year's numbers implied we would all be able to see clearly with 2020 vision. harhar.

This year has presented all kinds of challenges: economic, political, medical, emotional, among others. I can't imagine that any of us could have seen any of this coming. Can you remember how you felt about news reports describing the emergence of a novel virus near the end of the previous year? I remember lamenting early reports suggesting that we would all have to socially distance, given my belief that we were already too socially disconnected from one another. In retrospect, my attitudes were so naïve. and even quaint.

But we all made it, so now is the time to hope for better times ahead. And as a journal for psychological science, there ought to be plenty of angles for timely research emerging from recent events.

More personally, I have been fortunate to have energetic support from my new graduate student assistant, Kristen Julianne Wright. And students have continued to submit terrific manuscripts. In fact, after I finish writing this, I'm going to get started on copyediting the manuscripts for the Spring, 2021 issue of the journal.

Thanks for reading, and I look forward to reading your submissions to include in the Fall, 2021 issue of the journal.

Ken Sobel
Managing Editor
University of Central Arkansas

Journal of Psychological Inquiry
2020, Vol.24, No. 2, pp. 5-10

Elizabeth A Dahl, PhD., Award for Excellence in Undergraduate Research

TESTING THE RELATIONSHIP BETWEEN FITNESS AND COGNITION

LOGAN M. CRAWFORD AND HEATHER BAILEY
KANSAS STATE UNIVERSITY

Abstract – Research has shown that exercise interventions that produce increased cardiorespiratory fitness (Peak Vo2) also promote cognitive improvements in older adults (Colcombe & Kramer, 2003, Erickson, Leckie, & Weinstein, 2014, Vidoni et al, 2015). As such, the relationship between fitness and cognition is strongest for tests that rely on these brain regions, such as psychomotor speed, visuospatial processing, working memory, and attention (Colcombe & Kramer, 2003, Erickson et al., 2014). Previous research evaluating physical fitness and cognition in older adults has used single muscle group, repetitive aerobic exercises (e.g., walking on treadmills, riding stationary bikes). The present experiment was designed to evaluate whether High-Intensity Fitness Training (HIFT), a high-intensity style of aerobic and strength exercise that focuses on increasing cardiorespiratory fitness (CF), will also improve cognition in older adults. The participants who underwent the HIFT scored higher on tests for physical fitness (i.e. functional fitness and CF) as well as on cognitive tests for psychomotor speed, visuospatial processing, and attention. These results replicate previous work demonstrating a relationship between physical fitness and cognition in older adults and extend these results to high-intensity fitness training. Increases in functional fitness and CF that result from HIFT may lead to increased gray matter, cellular metabolism, and vascular growth in areas of heavy use during training.

Keywords: functional fitness, cognition, aging, cardiorespiratory fitness, intervention

A common misconception about aging is that all aspects of cognition will decline as people age and that these changes are inevitable. Even though several cognitive abilities show declines in healthy older adults, there are many that are maintained across the lifespan (Salthouse, 1994). Moreover, age-related declines in cognition are not inevitable: older adults demonstrate the ability to improve their attentional capacity, processing speed, visuospatial processing and memory (Erickson, Leckie & Weinstein, 2014). Because of this plasticity, cognitive interventions have become very popular in the cognitive aging literature. Many forms of cognitive training have been evaluated, but the vast majority of these have shown inconclusive results. On the market today are many supplements, brain games, and mind tricks that claim to help promote cognition by training the brain. Some have reported the promising results of cognitive interventions transferring into daily function (Tennstedt, & Unverzagt, 2013). However, usually individuals will show increased skill on the specific brain game that the individual trained with, but these improvements do not always transfer to real world scenarios, which is the intended target. Thus, it is important to identify the method that will give the greatest chance to maintain cognition over the lifespan. In this study, we will focus on a method that has shown the most promise in older adults: exercise and physical fitness.

Research in the area of exercise and cognition has produced results that are as expected: the more exercise that is completed, the more cognitive benefits (Colcombe & Kramer, 2003). This may be due, in part, to exercise increasing gray matter volume, cellular metabolism, and vasculature in the prefrontal cortex and hippocampus (Erickson, Hillman & Kramer, 2015), which are portions of the brain used heavily during exercise (Cotman, Berchtold & Christie, 2007). As such, the relationship between fitness and cognition is strongest for tests that rely on these brain regions, such as psychomotor speed, visuospatial processing, working memory, and attention (Colcombe & Kramer, 2003, Erickson et al., 2014). The theory behind these benefits is related to the relationship between exercise and physical fitness. Exercise causes various physiological adaptations, such as increased vasculature, proliferation of energy-producing mitochondria, and growth of muscle cells. Exercise is thought to improve cognition because these adaptations not only occur in skeletal muscle, but also in the brain. Cotman et al. (2007) report that exercise supports brain plasticity by increasing neurogenesis, metabolism, and vascular function. These physiological and neurological adaptations are thought to be the driving force behind the improvements in cognitive measures.

These results are well documented, but the relationship shows significant heterogeneous variance (i.e., individuals who completed more exercise did not always gain increased levels of cognition, whereas others did). However, when cardiovascular fitness (CF) is assessed rather than the amount of exercise, there is a much stronger correlation with cognitive performance (Erickson et al., 2014). One potential reason for this

effect is that CF is a more quantitatively precise measure and better represents how the human body is physiologically reacting to stress (e.g., exercise). For example, when two individuals are asked to exercise for identical sets of duration and intensity, their physiological adaptations will most likely vary. This variability depends on multiple factors such as previous training, shared experiences, and genetic factors (Bouchard & Rankinen, 2007).

The most widely accepted measure for CF is maximum oxygen uptake (VO_2 max), which is the rate at which an individual can take in oxygen and allocate it towards physical activity (Franklin et al., 2000). In this study, we used peak oxygen uptake (Peak VO_2), a derivative of VO_2 max, to measure CF. An individual's Peak VO_2 is the maximal amount of oxygen uptake attained during a test, whereas VO_2 max is the highest value that is possible for the individual to attain. Peak VO_2 provides how much energy an individual's body was able to put towards a certain exercise during testing.

Previous research that has tested the relationship between exercise and cognition has used similar aerobic exercise interventions in order to obtain increases in functional fitness. These exercise interventions usually use single muscle group or single exercise interventions, such as treadmill walking and stationary biking, which are two popular aerobic activities used in age-related exercise interventions. Increases in physical fitness are present in populations who undergo these exercises; however, these exercises use only one major muscle group (i.e., hamstring/quadriceps muscles). Other studies have used dance classes as an exercise (Emery & Gatz, 1990), which is a more dynamic type of exercise, but it still does not pose enough stress to the upper body in order to be classified as a full body workout.

The CF measure, VO_2 max, is often not used in studies involving sedentary older adults. The equipment and time required for this method, as well as the difficulties that arise when asking a sedentary person to exercise rigorously until their peak, make VO_2 max a difficult test to administer. These reasons brought us, and most other researchers, to the conclusion that, given the population we are studying, Peak VO_2 was the most appropriate measure.

High-Intensity Fitness Training (HIFT; a.k.a., High-Intensity Interval Training) is a type of exercise intervention with the goal of increasing cardiorespiratory fitness. It uses continuous intervals of high-intensity bouts of exercise followed immediately by lower intensity exercise bouts. This type of training requires the individual to switch between high and low intensity cyclically until completion of the workout. HIFT has been shown to produce powerful adaptations in fitness due to the high amount of stress that is put on the cardiorespiratory system during HIFT. Stress to the cardiorespiratory system allows for increased ability to respond to this stress (i.e., increased CF), while the low-intensity bouts allow a recovery period while still forcing the body systems to be poised to return to higher intensity exercise.

In addition to Peak VO_2, we evaluated functional fitness and its relationship with cognition in older adults. Functional fitness aims to train movements that are used in everyday life. For example, a squat would be utilized to simulate sitting down and standing from a chair or picking up objects from the floor. A double baseline test of functional fitness and CF was used to assess increases in both measures for those who took part in the exercise regimen, whereas the more sedentary individuals used a single post-test.

Thus, in the current study, we assessed fitness in two different ways (VO_2 Peak and functional fitness) as well as several cognitive processes including visuospatial processing, psychomotor speed, task switching, simple attention, working memory, and semantic knowledge. We may find that HIFT improves cognitive abilities in cognitively healthy older adults – especially those that rely on the prefrontal cortex. However, due to the greater focus on functional strength rather than aerobic fitness training, it is also possible that an HIFT intervention will not produce cognitive improvements if it does not increase CF.

Method

Study Design

Sixteen physically able adults, aged 63 or older, without cognitive impairment were recruited to take part in this study. Seven of these participants had recently completed an 8-week HIFT exercise intervention and are referred to as the *Fitness Group* (FG). Nine participants, who based on self-reported activity questionnaire (included questions on frequency and duration of daily physical activity and exercise, as well as exertion level reached, over the last 8 weeks), were more sedentary than their FG counterparts and served as our Control Group (CG).

Fitness was measured twice (at baseline and post-intervention) for the FG, but only once for the CG, using a Functional Performance Test (FPT). The CG underwent the Functional Performance Test (FPT) – our measure of functional fitness – at the same time the FG completed their post-intervention FPT. Participants were scheduled individually to come into the Memory and Aging Lab and complete a battery of cognition tests within one week of completing the FPT.

Participants

The seven participants (Mean Age: 69.9, SD = 3.9) in the FG were recruited from an existing study being conducted through the Kinesiology Department of Kansas State University (KSU). The purpose of this study was to assess if an HIFT program could improve ability and confidence to complete everyday functional activities, especially those involving balance (e.g., carrying objects,

standing up from a chair, climbing stairs). The CG (Mean Age: 73, SD = 8.9) was recruited from a database of older adults maintained by the second author's laboratory (i.e., Heather Bailey). Individuals were not considered for participation if they had completed more than one hour of vigorous exercise per week during the prior 3 months, had any cognitive impairment, or used any cardiovascular modulating drugs or devices, such as β-blockers, ace inhibitors, or pacemakers. Data on their activity level was taken via self-assessment over the phone and again before their functional fitness test with a questionnaire. As seen in Table 1, individuals from the FG and CG did not differ significantly in age, $t(14) = 1.16$, $p = .27$, or in education level, $t(14) = 0.18$, $p = .86$.

Table 1

Participant data

	Fitness Group (n=7)	Control Group (n=8)	Combined (n=15)
Mean Age	69.9 years, SD= 39	73 years, SD = 8.9	71.4 years, SD = 6.8
Mean Education level	17.3 years	14.9 years	16.1 years
Percent Female	74.4%	42.8%	57%

Intervention

The HIFT intervention was completed at the Functional Intensity Training (FIT) lab on KSU campus. The exercise regimen was modeled on a prior CrossFit training template used by the FIT lab and created by Certified Personal Trainers who had experience with older adults. This exercise regimen was conducted two days per week for one-hour sessions for eight weeks. Participants exercised as a group, with all participants completing 16 workouts during the intervention. Workouts varied by type, such as metabolic conditioning (walking, cycling, swimming, or dancing), gymnastic (push-ups, pull-ups, squats), and weightlifting (presses, deadlifts, and kettlebell swings) exercises. All workouts were modulated based on the relative difficulty perceived by each participant (e.g., push-ups on knees instead of feet, 8kg kettlebell instead of 12 kg kettlebell)

Measures

Functional Fitness Measures. Our primary functional fitness measure used a Functional Performance Test (FPT), which included five subtests: Six-Minute Walk test (6MW), Seated Timed Up & Go (STUP), Lift and Carry test (LC), Chair Stand test (CHS), and Stair Climb (STC). See Table 2 for details about each subtest.

Table 2

Descriptions of the five subtests from the Functional Performance Test

FPT Subtest	Description of Subtest
Six-Minute Walk test	A submaximal test of aerobic ability completed on a 400m indoor track. Upon start of the test, a tester would yell "GO", participants would then walk the greatest distance possible to them until the six-minute time limit was reached and the tester yelled "STOP". The distance was recorded in meters and laps.
Seated Timed Up & Go	An assessment of basic mobility, strength, and balance. It involves the time an individual requires to stand from a folded chair (seat, 17 in. high, and back placed against the wall), walk 3 meters, turn around, return to the chair, and sit down again as quickly as possible.
Lift and Carry test	An assessment of the participant's ability to walk 5 meters to an 8 kg object that is knee high off the ground, pick it up, carry the object 10 meters and place it on a shoulder height shelf.
Chair Stand test	An assessment of lower body strength that requires the participant to rise and sit 5 times as quickly as possible from a folded chair of the same specifications as that of the STUP.
Stair Climb	An assessment of lower body strength, as well as balance. It is scored for the time it takes a participant to ascend and descend a flight of 10 steps three times.

Our primary cardiovascular fitness measure was a comparative group difference in cardiorespiratory fitness, measured by mean peak oxygen consumption normalized to body mass (peak VO_2, mL/kg/min). This was calculated using data from the 6MW with the following formula: Mean Peak VO_2 (mL/kg/min) = 4.948 + 0.023 * Mean 6MW distance (meters) (SEE 1.1 mL/kg/min)

Cognitive measures. Our primary cognitive measures were chosen to sample from six different cognitive constructs used in similar interventions: Visuospatial Processing, Psychomotor Speed, Simple Attention, Task Switching, Working Memory, and Semantic Knowledge. These domains were tested using a battery of cognitive measures described in Table 3.

Table 3

Descriptions of the tasks used to measure the six cognitive constructs

Task	Cognitive Constructs	Description
Trail Making parts A & B	Visuospatial Processing, task switching, simple attention	Part A involves consecutively connecting the numbers 1-25 with a line on a piece of paper as quickly as possible. Part B involves drawing a similar line, connecting alternating symbols and numbers in a consecutive sequence as quickly as possible.
Vocabulary test	Semantic knowledge	Participants had four minutes to answer 35 multiple choice vocabulary questions.
Letter and Pattern Comparison	Psychomotor speed	This task requires the participant to compare one line of text or pattern. If the patterns or letters are the same the participant was to write an 'S', if different: a 'D.' Two pages of patterns and line of letters each were given to the participant and they were told they would have 30 seconds to complete as many comparisons as they could, then we would go to the next page and repeat that same task.
OPSAN	Working memory	This task is completed via computer and requires the participants to solve a set of math problems while remembering a set of unrelated words and then recall the words in the order presented to them (Unsworth, Heitz, Schrock, Engle, 2005). The participant has four seconds to complete each math problem, after this time a word will appear for the same amount of time. After several math problems and words, a text box will appear in which participants are to record all words, this cycle repeats ten times. The number of words/math problems that appear in each cycle ranges from 3 to 7.

Procedure

After participants in the fitness group completed the 8-week intervention, they completed their post-intervention functional fitness measures and then were scheduled to come into the Memory & Aging Lab at Kansas State University to complete their cognitive measures. Participants in the control group first

completed the functional fitness measures and then were scheduled to complete their cognitive measures. Once they arrived at the Memory & Aging Lab, participants filled out an informed consent form and completed a questionnaire asking their age, gender, ethnicity, and years of education. This was followed by the Letter and Pattern Comparison task, Trail Making Part A & B, vocabulary test, and OSPAN.

Results

Functional Fitness Outcomes

We conducted independent-samples t-tests on each of the fitness measures comparing results from the FG and the CG (see Table 4). Results indicated that FG outperformed the CG on the Seated Timed Up & Go task, $t(14) = 2.0$, $p = .033$, and on the Lift and Carry task, $t(14) = 1.91$, $p = 0.041$. We also observed heightened levels of cardiorespiratory fitness and functional fitness in our FG group compared to our CG group, as measured by Peak VO_2, $t(14) = 1.15$, $p = .135$, the 6-minute Walk Test, $t(14) = 1.16$, $p = .136$, the Chair Stand, $t(14) = 1.08$, $p = .15$, and the Stair Climb, $t(14) = 1.10$, $p = .15$; however, these differences in fitness were only marginally significant.

Table 4

Mean cardiovascular and functional fitness change between FG and CG

	Fitness Group (n = 7)	Control Group (n = 8)	% Difference	*p*
Peak VO_2	19.06 mL/kg/min	17.98 mL/kg/min	6.0%	0.13
6 Minute Walk Test distance	613.59 meters	566.63 meters	8.3%	0.14
Seated Timed Up & Go	6.21 sec	7.97 sec	22.1%	**0.03**
Lift and Carry	13.96 sec	17.29 sec	19.3%	**0.04**
Chair Stand	9.25 sec	10.78 sec	14.2%	0.15
Stair Climb	31.35 sec	37.03 sec	15.3%	0.15

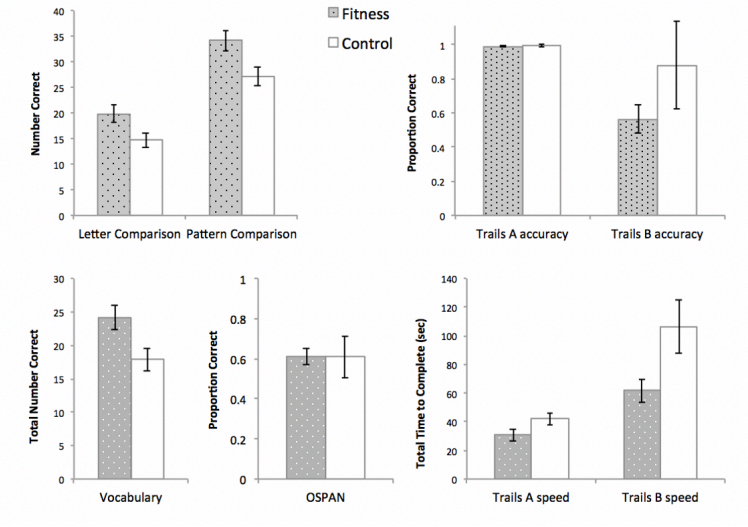
Cognitive Outcomes

Next, we conducted independent-samples t-tests on each of the cognitive variables (see Table 3). Results indicated that the FG outperformed the CG on multiple measures of processing speed and vocabulary knowledge. Specifically, the FG group performed better on the Letter Comparison task, $t(14) = 2.06$, $p = .03$, the Pattern Comparison task, $t(14) = 2.28$, $p = .02$, Trails A speed, $t(14) = 2.0$, $p = .033$, and Trails B speed, $t(14) = 2.19$, $p = .026$. Surprisingly, the FG outperformed the CG on the vocabulary test, $t(14) = 2.77$, $p = .008$.

We expected to find group differences in *accuracy* on Trails A and Trails B; however, these differences were only marginal for Trails B, $t(14) = 1.18$, $p = .155$. Further, we predicted group difference in working memory performance, but these differences were non-significant, $t(8) = 0.12$, $p = .455$. This most likely was due to several participants finding that the OSPAN task was too difficult and chose to terminate the task early. Therefore, we were only able to include data for 5 FG and 5 CG participants.

Figure 1

Performance on the cognitive measures by group. Error bars are standard error of the mean.



Discussion

The current study evaluated whether participating in High-Intensity Fitness Training (HIFT) was associated with higher performance on measures of cognition compared to non-participation. Three important findings were observed. First, the HIFT intervention was associated with higher levels of functional fitness in the fitness group as measured by the Functional Performance Test. Second, older adults who completed HIFT outperformed the control group on multiple cognitive measures, most notably on tasks measures processing speed and attention. Third, the fitness group scored higher on a vocabulary test compared to the control group. Our results––including higher levels of speed and attention in older adults––replicate findings from other studies that have evaluated the effects of exercise and cardiorespiratory fitness (Colcombe & Kramer, 2003, Erickson et al., 2014). However, we have observed similar effects following a high-intensity fitness intervention in older adults.

We expected to find higher working memory performance in our fitness group but that was not the case. It should be noted that several participants (2 from the fitness group and 4 from the control group) were unable to complete the OSPAN task due to computer error, frustration or fatigue. Another surprising result was that our fitness group scored better on a test of semantic knowledge (i.e., the vocabulary test). We predicted no group differences in semantic knowledge

given that the physiological changes that result from increased fitness should not affect this stable cognitive ability. However, it is possible that the HIFT intervention led to physiological changes (e.g., neurogenesis, cellular metabolism, and vascular growth) in brain regions involved in the retrieval of semantic knowledge, such as the hippocampus (e.g., Manns, Hopkins & Squire, 2003). Another potential explanation for the higher semantic knowledge performance is related to the sex of our participants. Colcombe and Kramer (2003) found that increases in fitness lead to greater changes in cognition in older adult females compared to older adult males. Our fitness group had a higher percentage of females, 74.4%, than our control group, 42.8%, which may explain the boost in vocabulary knowledge.

Limitations

Because this study took place in collaboration with a pilot study in the FIT lab, there are two notable limitations: Sample size and no random assignment. First, we believe if a larger sample of older adults would have completed the functional fitness and cognitive battery, then we would have had more power to detect significant effects in additional measures. For instance, we observed trends on several fitness measures (e.g., Peak VO_2, 6-minute walk test, chair stand, and stair climb) in which our fitness group was outperforming our control group, but these group differences did not reach statistical significance––presumably from low statistical power. Second, given that the HIFT intervention was part of an ongoing study, we were unable to randomly assign older adults into the fitness versus control groups. Although there may be issues with self-selection, we feel as if our two groups were fairly equivalent to one another––e.g., in terms of age and educational levels––before the fitness group underwent the intervention.

Conclusion

We found that individuals who underwent High-Intensity Fitness Training had greater levels of functional fitness and cognitive abilities. This study provides evidence that functional fitness is associated with higher levels of cognition in older adults. With the widespread availability of these types of exercises, HIFT can be an important therapeutic tool for older adults who want to achieve cognitive benefits.

Although much research has been completed on the relationship between exercise and cognition, there is a need for research focused on the cognitive effects different types of dynamic exercise regimens that target multiple muscle systems produce in older adults. This intervention is in place of single muscle exercise regimens.

References

Arbuthnott, K., & Frank, J. (2000). Trail Making Test, Part B as a Measure of Executive Control: Validation Using a Set-Switching Paradigm. *Journal of Clinical & Experimental Neuropsychology*, *22*, 518-528.

Colcombe, S., & Kramer, A. (2003). Fitness Effects on the Cognitive Function of Older Adults a Meta-Analytic Study. *Psychological Science*, *14*, 125-130.

Colcombe, S., & Kramer, A. (2003). Fitness Effects on the Cognitive Function of Older Adults a Meta-Analytic Study. *Psychological Science*, *14*, 125-130.

Cotman, C., Berchtold, N., & Christie, L. (2007). Exercise builds brain health: key roles of growth factor cascades and inflammation. *TRENDS in Neurosciences*, *30*, 9.

Emery, C., & Gatz, M. (1990). Psychological and Cognitive Effects of an Exercise Program for Community-Residing Older Adults. *The Gerontologist*. 30(2), 184–188.

Erickson KI, Hillman CH, Kramer AF (2015). Physical activity, brain, and cognition. Current Opinion in Behavioral Sciences. 4, 27–32.

Erickson, K. I, Leckie, R. L., & Weinstein, A. M. (2014). Physical activity, fitness, and gray matter volume. *Neurobiology of Aging, 35,* S20-28.

Franklin, B., Whaley, M., & Howley, E. (2000). ACSM's guidelines for exercise testing and prescription. *American College of Sports Medicine*, 6th ed.

Manns, J. R., Hopkins R. O., Squire L. R. (2003). Semantic memory and the human hippocampus. *Neuron*. 38, 127-33.

Ross, R., Murphym J., Wollak, I., Jackson, A. (2010). The six-minute walk test accurately estimates mean peak oxygen uptake. *BMC Pulmonary Medicine*. 10:31.

Salthouse, T. A. (1994). The Nature of the Influence of Speed on Adult Age Differences in Cognition. *Developmental Psychology, 30,* 240-259.

Tennstedt, S.L., & Unverzagt, F.W. (2013). The ACTIVE Study: Study Overview and Major Findings. Journal of Aging and Health, 25(8suppl), 3S-20S.

Unsworth, N., Heitz, R. P., Schrock, J. C., Engle, R. W., (2005). An automated version of the operation span task. *Behavior Research Methods, 37,* 498-505.

Vidoni, E. D., Johnson, D. K., Morris, J. K., Van Sciver, A., Greer, C. S., et al (2015). Dose-Response of Aerobic Exercise on Cognition: A Community-Based, Pilot Randomized Controlled Trial. *PLoS ONE*, *10*, e0131647

Author Note
A special thank you to the collaborators at the F.I.T. lab, most notably Cheyenne Becker and Katie Heinrich, without whom this research would not have been possible and an additional thank you goes out to Kristen, Chelsea, Amanda, and Bailey for their assistance in this research.

Journal of Psychological Inquiry
2020, Vol.24, No. 2, pp. 11-16

BIG FIVE PERSONALITY TRAITS OF STUDENTS, PERCEIVED TRAITS OF INSTRUCTORS, AND STUDENT-INSTRUCTOR RAPPORT

CHRISTONI KEY AND DARIAN MCCLUSKEY
UNIVERSITY OF CENTRAL ARKANSAS

Abstract – This study examined relationships between student Big Five personality traits and student-instructor rapport, perceived instructor Big Five personality traits and rapport, and similarity between student and instructor Big Five personality traits and rapport. Big Five personality traits include: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. "Rapport" is a term that describes a trusting, caring, and respectful relationship, and student-instructor rapport has been found to result in positive student academic outcomes. Sixty undergraduate students in psychology courses completed an online questionnaire that assessed student Big Five personality traits, perceived instructor Big Five personality traits, and student-instructor rapport. Results showed that student personality traits did not predict rapport. All five perceived instructor personality traits predicted rapport: perceived instructor openness, conscientiousness, extraversion, and agreeableness correlated positively with rapport, whereas perceived instructor neuroticism correlated negatively with rapport. Results provide instructors an opportunity to develop higher levels of student-instructor rapport with their students by considering traits they express when teaching.

Keywords: similarity, Big Five traits, student-instructor rapport, perceived instructor personality, classroom Big Five Personality Traits of Students, Perceived Traits of Instructors, and Student-Instructor Rapport

In the context of academic success, many factors contribute to whether a student thrives or experiences difficulties while obtaining an education. Previous studies show the importance of forming and maintaining positive relationships within the educational setting and how these relationships can aid successful academic performance (Hagenauer & Volet, 2014; Juvonen, 2006; Lammers & Gillaspy, 2013; Lammers et al., 2017; Wilson et al., 2010; Wilson et al., 2012). Research shows that positive communication between students and instructors outside of the classroom plays a crucial role in whether a student continues their studies with an institution (Jaasma & Koper, 1999). Conversely, negative emotions associated with unfavorable relationships have been found to potentially lead a student to disconnect from their academic setting, therefore hindering success (Juvonen, 2006).

Rapport describes a relationship that is friendly in nature and has been found to be crucial in its connection to the perceived effectiveness of instructors. Students who reported having positive rapport with an instructor also reported being more interested in the material covered in class, more likely to attend class, and more likely to engage in other academically beneficial behaviors (Wilson et al., 2010). Increase in learning (Lammers & Gillaspy, 2013), enjoyment of learning (Benson et al., 2005; Buskist & Saville, 2001), and experiencing less test anxiety (Creasey et al., 2009) have also been found to positively correlate with student-instructor rapport. Because rapport is such an important tool to have in an academic setting, it would be beneficial to know what factors predict a positive student-instructor relationship.

There are a variety of factors that may contribute to the way a student decides to interact with their instructor. The probability of a student making contact with an instructor outside of class can be established by the nature of an instructor's behavior while in the classroom (Jaasma & Koper, 1999). Traits of an instructor such as enthusiasm and approachability have been rated by students as being important to learning (e.g., Buskist et al., 2002). Another study also found similar results in how traits of instructors perceived by students predicted outcomes of how the instructors are rated on evaluations (Jenkins & Downs, 2001). The way a student perceives an instructor's teaching effectiveness can be determined more so by the instructor's personality traits rather than their actual teaching methods. Therefore, it may be possible that certain personalities can elicit higher evaluation ratings no matter the level of knowledge or experience the instructor actually possesses.

The Big Five personality traits are a commonly used personality measure that is comprised of five dimensions of personality including openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (McCrae & Costa, 1987). All of the Big Five personality traits have been found to correlate positively with student evaluations except for the trait of neuroticism, which had a negative correlation with student evaluations of teaching effectiveness

(Patrick, 2011). Although instructor personality traits have been shown to predict rated effectiveness of instructors, it is important to note that different traits are favored in different situations such as the type of course and student demographics (Murray et al., 1990).

Thus, several studies indicate that the personality traits of instructors correlate with how their students perceive the effectiveness of their teaching. However, few studies examine what role the student's personality plays in predicting student-instructor rapport. One study that examined how student personality connected to the perception of instructor effectiveness found that only agreeableness showed a positive correlation with student evaluations of their instructors (Patrick, 2011). In contrast, the study found that personality traits of the instructor (extraversion, openness, agreeableness, and conscientiousness) correlated positively with perceived effectiveness ratings. These findings show that self-reported personality traits of students have not generally been found to correlate with how a student rates the quality of an instructor, yet the degree of congruence in student and instructor personality may be an important factor that has not been researched.

From a social psychology perspective, similarity in personality could be a factor that increases the way a student perceives their instructor, because people tend to like individuals who are similar to themselves (Wilson & Ryan, 2012). When accounting for how people perceive personality similarity between themselves and a stranger, individuals are more likely to be socially attracted to those they perceived as being highly similar. Similarity promotes a sense of comfort because it reinforces how an individual views themselves (Byrne et al., 1967). When a student is paired with an instructor who possesses similar personality traits to their own, it can lead to more positive feelings in the learning environment and therefore predict how well the student retains the information they are given in class (Varela et al., 2011). Meanwhile, dissimilarity has the opposite effect, creating discomfort (Varela et al., 2011). Perhaps students feel more comfortable interacting with an instructor when they perceive the instructor as being similar in the context of their own personality. Examining whether the instructor's personality or similarity of personality between students and instructors predicts rapport can be advantageous, as the benefits of student-instructor rapport is a relevant across all educational levels (Lammers & Gillaspy, 2013).

The literature discussed provides a basis to explore how student personality, perceived instructor personality, and perceived similarity in personality between students and instructors relates to student-instructor rapport. From this information, it can be inferred that a student's perception of their instructor's personality may be a fitting way to assess an instructor's personality in the context of measuring rapport. Problems with academic success can be avoided by creating a better understanding of what predicts the quality of a student's relationship with an instructor. Although studies have shown the significance of instructor personality on student-instructor rapport, there is still room to explore the ways in which perceived student-instructor personality similarity predicts the formation of a positive relationship between a student and an instructor. The present study seeks to explore how aspects of personality (instructor, student, and similarity in personality) correlate with student-instructor rapport. We predicted that the student's perceived personality similarity of themselves and the instructor will be positively correlated with student-instructor rapport. Additionally, we predicted that instructor personality will correlate with student-instructor rapport while the student's personality alone will have little to no correlation with student-instructor rapport.

Method

Participants

Participants consisted of 60 University of Central Arkansas undergraduate students enrolled in psychology courses. Of the participants, about 78% identified as women (n=47), 20% identified as men (n=12), and about 2% selected other (n=1). Age of participants ranged from 18 to 41. Race/ethnicity of participants included 66.7% white (n=40), 18.3% African American/Black (n=11), 11.7% Hispanic/ Latino (n=7), and 3.3% other (n=2). Participation in this study resulted in enrichment credit or extra credit for a psychology course. We treated all participants in accordance with APA ethical standards.

Materials

Qualtrics. Qualtrics is an online software that allows researchers to create and administer surveys. We used page breaks to make the survey flow and a progress bar that allowed participants to see their completion status.

Student-Instructor Rapport Scale-9 (SIRS-9). The SIRS-9 is a nine-item survey developed by Lammers and Gillaspy (2013) that measures a student's perceived rapport with an instructor. All nine items are rated on a Likert-scale from 1 (not at all) to 5 (very much so). A higher score on the scale indicates a higher level of student-instructor rapport.

Big Five Personality Inventory. We used John and Srivastava's (1999) Big Five Inventory to measure personality. It contained 44 statements that measured openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Each item presented a description of a personal quality or likely behavior and participants rated it on a scale that ranged from 1 (disagree strongly) to 5 (agree strongly). Of the 44 items, 10 measured openness to experience, 9 measured conscientiousness, 8 measured extraversion, 9 measured agreeableness, and 8 measured neuroticism. Sixteen of the items are reverse-scored items (John & Srivastava, 1999).

Procedure

Near the middle of the semester, participants came to the psychology lab and sat at a computer. Students clicked on a link that brought them to the Qualtrics survey. Participants read the informed consent before starting. Next, the survey displayed a statement informing them about us, our appreciation of honest feedback, and their anonymous responses. Students provided demographic information then took the Big Five inventory for themselves. After that, we displayed a screen that instructed them to think about the second instructor they have during their week of classess. After reading the statement, they completed the personality scale again for that instructor, then completed the SIRS-9 with the same instructor in mind. At the end, participants read the debriefing form.

Results

Though we initially obtained responses from 65 participants, we did not include data from five participants because they did not answer all items. Our analysis included 60 students that each provided a score for their Big Five personality traits, their instructor's Big Five personality traits, and a rapport score from the SIRS-9 that asked participants to rate each of nine rapport statements from one to five. To obtain a student-instructor rapport score, we calculated a mean score from the nine items. To measure the Big Five personality traits, we used the John and Srivastava (1999) Big Five 44 item scale to measure openness, conscientiousness, extraversion, agreeableness, and neuroticism on a rating scale of one to five. In order to obtain a Big Five score, we reverse scored indicated items before calculating mean openness, conscientiousness, extraversion, agreeableness, and neuroticism scores for each participant and for their instructor.

We assessed internal scale reliability for each of our scales. For the SIRS-9, Cronbach's Alpha = .98. Table 1 shows the Cronbach's Alpha values for the personality subscales of the student and the instructor. The values show that the scales demonstrated internal reliability.

Table 1.

Cronbach's Alpha values to assess scale reliability for each personality subscale.

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Student	.80	.78	.88	.76	.85
Instructor	.82	.90	.79	.81	.65

Our first hypothesis stated that there would be significant relationships between perceived instructor personality traits and student-instructor rapport. Our second hypothesis predicted that student personality would not correlate with student-instructor rapport. Lastly, we expected that there would be significant relationships between personality similarity and rapport.

Table 2 shows mean scores of student personality and perceived instructor personality. One can see that the mean score for each variable was above the midpoint of the scale (3.0) with the exception of instructor neuroticism. The overall mean rapport score (M = 3.90) was above the midpoint of the scale (3.0). Figures 1-5 depict the significant correlations found between perceived instructor personality traits and student-instructor rapport. One can see that perceived instructor openness, extraversion, conscientiousness, and agreeableness all positively correlated with student-instructor rapport whereas perceived instructor neuroticism negatively correlated with student-instructor rapport.

Table 2

Mean scores for student personality, perceived instructor personality, and rapport scores.

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Student	3.55	3.70	3.39	3.99	3.10
Instructor	3.59	3.88	4.21	3.66	2.49

To assess the ability of each personality variable to predict student-instructor rapport and to assess whether the similarity in personality between student and instructor accounted for additional variance in predicting rapport, we performed a series of hierarchical linear regression analyses. First, we centered student personality scores, perceived instructor personality scores, and rapport scores by subtracting the respective mean from each participant score. Second, we calculated an interaction term by multiplying the student personality score by the perceived instructor personality score. We then entered the centered student personality score and the centered instructor personality score into the first step of the regression analyses and the interaction term into the second step. If similarity in student and instructor personalities is an important factor in predicting student-instructor rapport, then we would expect the interaction term to be significant. For each personality dimension, the data met assumptions regarding linearity, homoscedasticity, and outliers by examining scatterplots and also met assumptions regarding multicollinearity. All correlation coefficients among predictor variables were less than .80, VIF scores were less than 10, and Tolerance scores were greater than .01.

For the personality dimension of openness, regression analysis showed that student openness did not significantly predict student-instructor rapport, perceived instructor openness did significantly predict student-instructor rapport, and the interaction of the predictors did not add any significant predictive power. For step 1 (2 independent predictors), regression analysis showed R^2 = .357, F (2, 57) = 15.80, p < .001. Specifically, for student openness, results showed b = -.02, t = -.17, p = .87 and 95% CI = -.46 to .39. For instructor openness, results

showed b = .60, t = 5.32, p < .001 and 95% CI = .69 to 1.53. For step 2 (2 independent predictors + interaction), regression analysis showed R^2 Change = .010, F Change (1, 56) = .89, p = .35 and 95% CI = -.90 to .33.

For the personality dimension of conscientiousness, regression analysis showed that student conscientiousness did not significantly predict student-instructor rapport, perceived instructor conscientiousness did significantly predict student-instructor rapport, and the interaction of the predictors did not add any significant predictive power. For step 1 (2 independent predictors), regression analysis showed R^2 = .535, F (2, 57) = 32.73, p < .001. Specifically, for student conscientiousness, results showed b = -.04, t = -.42, p = .68 and 95% CI = -.45 to .29. For instructor conscientiousness, results showed b = .74, t = 8.01, p < .001 and 95% CI = .76 to 1.26. For step 2 (2 independent predictors + interaction), regression analysis showed R^2 Change < .001, F Change (1, 56) = .03, p = .87 and 95% CI = -.50 to .42.

For the personality dimension of extraversion, regression analysis showed that student extraversion did not significantly predict student-instructor rapport, perceived instructor extraversion did significantly predict student-instructor rapport, and the interaction of the predictors did not add any significant predictive power. For step 1 (2 independent predictors), regression analysis showed R^2 = .244, F (2, 57) = 9.21, p < .001. Specifically, for student extraversion, results showed b = .05, t = .39, p = .70 and 95% CI = -.25 to .36. For instructor extraversion, results showed b = .50, t = 4.29, p < .001 and 95% CI = .49 to 1.36. For step 2 (2 independent predictors + interaction), regression analysis showed R^2 Change = .004, F Change (1, 56) = .33, p = .57 and 95% CI = -.63 to .35.

For the personality dimension of agreeableness, regression analysis showed that student agreeableness did not significantly predict student-instructor rapport, perceived instructor agreeableness did significantly predict student-instructor rapport, and the interaction of the predictors did not add any significant predictive power. For step 1 (2 independent predictors), regression analysis showed R^2 = .754, F (2, 57) = 87.20, p < .001. Specifically, for student agreeableness, results showed b = .07, t = 1.03, p = .31 and 95% CI = -.14 to .44. For instructor agreeableness, results showed b = .85, t = 12.40, p < .001 and 95% CI = 1.07 to 1.49. For step 2 (2 independent predictors + interaction), regression analysis showed R^2 Change = .003, F Change (1, 56) = .72, p = .40 and 95% CI = -.45 to .18.

For the personality dimension of neuroticism, regression analysis showed that student neuroticism did not significantly predict student-instructor rapport, perceived instructor neuroticism did significantly predict student-instructor rapport, and the interaction of the predictors did not add any significant predictive power. For step 1 (2 independent predictors), regression analysis showed R^2 = .497, F (2, 57) = 28.19, p < .001. Specifically, for student neuroticism, results showed b = -.11, t = -1.12, p = .27 and 95% CI = -.42 to .12. For instructor neuroticism, results showed b = -.69, t = -7.39, p < .001 and 95% CI = -1.69 to -.97. For step 2 (2 independent predictors + interaction), regression analysis showed R^2 Change < .001, F Change (1, 56) = .03, p = .86 and 95% CI = -.38 to .46.

Figure 1.

Scatterplot showing the positive correlation between perceived instructor openness and student-instructor rapport.

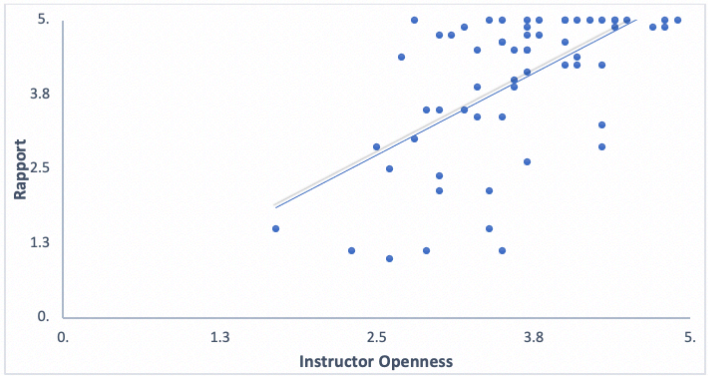


Figure 2.

Scatterplot showing the positive correlation between perceived instructor conscientiousness and student-instructor rapport.

Figure 3.

Scatterplot showing the positive correlation between perceived instructor extraversion and student-instructor rapport.

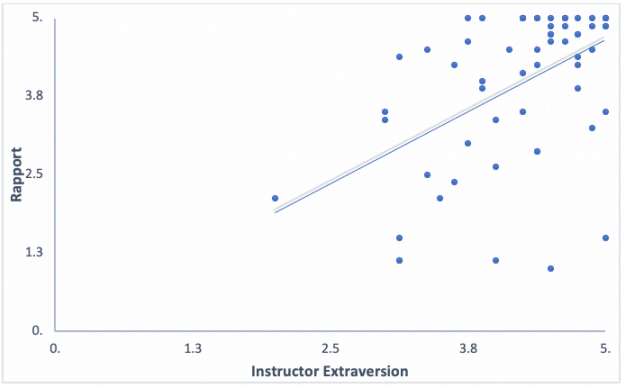


Figure 4.

Scatterplot showing the positive correlation between perceived instructor agreeableness and student-instructor rapport.

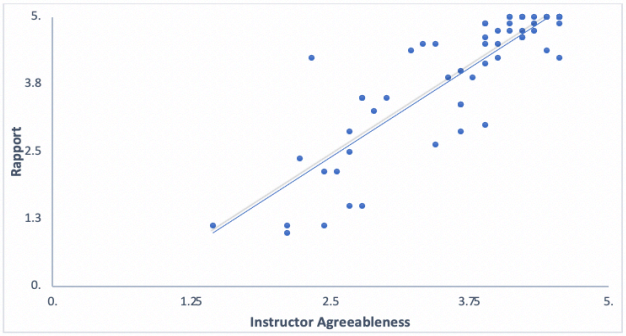
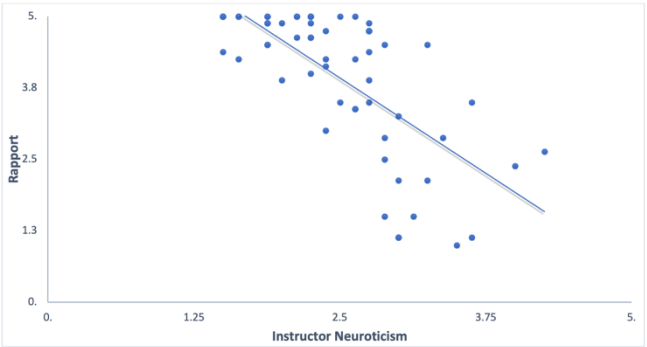


Figure 5.

Scatterplot showing the negative correlation between perceived instructor neuroticism and student-instructor rapport.



Discussion

Our first hypothesis stated that the perceived instructor's personality would predict how the student rated their student-instructor rapport. Results from our analysis fully support this hypothesis. Perceived instructor openness, extraversion, conscientiousness, and agreeableness all positively correlated with student-instructor rapport whereas perceived instructor neuroticism negatively correlated with student-instructor rapport. Our second hypothesis predicted that student personality would not predict student-instructor rapport. In support of this hypothesis, regression analyses showed that none of the student personality dimensions significantly predicted student-instructor rapport. Finally, for each personality dimension, the data did not support the hypothesis predicting a correlation between student-instructor personality similarity and student-instructor rapport. That is, student personality and perceived instructor personality did not interact to predict student-instructor rapport.

Results of this study agree with those found by Patrick (2011) in which instructor openness, conscientiousness, extraversion, and agreeableness all positively correlated with how students rated their instructors while neuroticism negatively correlated with instructor ratings. Previous studies such as the study by Byrne et al. (1967) found people have the tendency to be socially attracted to those who they perceive to be similar to themselves. Although we initially predicted that similarity between student and instructor would correlate with the level of rapport between the two, the results of this study did not support this concept.

One limitation of this study is that we measured instructor personality by having students complete the personality questionnaire for their instructor. Thus, we had a limited report of the instructors' personalities that may not be accurate due to the student's limited interactions with the instructor. In a classroom setting, it may be difficult to observe traits such as openness to experience in an instructor. Items assessing openness to experience include statements such as, "has few artistic interests" and "is sophisticated in art, music, or literature". Instructors have a limited amount of time to teach information needed for the course and may not be able to express their values and interests that do not pertain to the class. This may influence students to score items in a different way than their instructors would when taking the personality questionnaire.

As previously described, it has been found that students who perceive having positive rapport with an instructor also report being more engaged and academically motivated (Wilson et al., 2010). Data from this study and other similar studies can be used to further understand how instructors play a role in the academic success of students. Instructors could consider strategies to increase their openness to experience, conscientiousness, extraversion, agreeableness, and decreasing their neuroticism in order to have a better opportunity to build rapport with their students. The way in which instructors display personality traits in an

academic setting predicts the level of rapport they have with their students, which also can predict academic success of students.

Future research should include a wider diversity of students so results can be more representative and applicable. Another idea for future research is to have instructors participate in the study in order to gain more accurate personality scores. Self-reported instructor personality scores could be compared to personality scores perceived by students to assess whether there is a significant difference. Finally, future studies should continue to explore how personality variables in the classroom predict both student-instructor rapport and student's level of academic success.

References

Benson, T. A., Cohen, A. L., & Buskist, W. (2005). Rapport: Its relation to student attitudes and behaviors toward teachers. *Teaching of Psychology*, *32,* 237-239.

Buskist, W., & Saville, B. K. (2001). Rapport-building: Creating positive emotional contexts for enhancing teaching and learning. *APS Observer, 14*(3), 12-13.

Buskist, W., Sikorski, J., Buckley, T., & Saville, B. K. (2002). Elements of master teaching. In S. F. Davis & W. Buskist (Eds.), *The teaching of psychology: Essays in honor of Wilbert J. McKeachie and Charles L. Brewer* (pp. 27–39). Mahwah, NJ: Lawrence Erlbaum.

Byrne, D., Griffitt, W., & Stefaniak, D. (1967). Attraction and similarity of personality characteristics. *Journal of Personality and Social Psychology, 5*(1), 82–90.

Hagenauer, G., & Volet, S. E. (2014). Teacher-student relationship at university: An important yet under-researched field. *Oxford Review of Education, 40*, 370-388. https://doi.org/10.1080/03054985.2014.921613

Harris, K., & Vazire, S. (2016). On friendship development and the big five personality traits. *Social and Personality Psychology Compass, 11*, 647-667. https://doi.org/10.1111/spc3.12287.

Jaasma, M. A., & Koper, R. J. (1999). The relationship of student-faculty out-of-class communication to instructor immediacy and trust and to student motivation. *Communication Education, 48*(1), 41–47.

John, O. P., & Srivastava, S. (1999). The big-five trait taxonomy: history, measurement, and theoretical perspectives. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research (Vol. 2, pp. 102–138)*. New York: Guilford Press.

Jenkins, S. J., & Downs, E. (2001). Relationship between faculty personality and student evaluation of courses. *College Student Journal, 35*(4), 636–640.

Juvonen, J. (2006). Sense of Belonging, Social Bonds, and School Functioning. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of educational psychology*. (pp. 655–674). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Lammers, W. J., & Gillaspy, J. A., Jr. (2013). Brief measure of student-instructor rapport predicts student success in online courses. International Journal *for the Scholarship of Teaching and Learning, 7(2), Article 16.*

Lammers, W. J., Gillaspy, J. A., Hancock, F. (2017). Predicting academic success with early, middle, and late semester assessment of student–instructor rapport. *Teaching of Psychology, 44*(2), 145-149.

McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology, 52*(1), 81–90. https://doi-org.ucark.idm.oclc.org/10.1037/0022-3514.52.1.81

Murray, H. G., Rushton, J. P., & Paunonen, S. V. (1990). Teacher personality traits and student instructional ratings in six types of university courses. *Journal of Educational Psychology, 82*(2), 250–261.

Park, A. (2019). Personality and relationships. Personal communication.

Patrick, Carol L. (2011). Student evaluations of teaching: Effects of the Big Five personality traits, grades and the validity hypothesis. *Assessment & Evaluation in Higher Education, 36*(2), 239-249.

Varela, O. E., Cater, J. J., III, & Michel, N. (2011). Similarity attraction in learning contexts: An empirical study. *Human Resource Development Quarterly, 22*(1), 49–68.

Wilson, J. H., Ryan, R. G., & Pugh, J. L. (2010). Instructor-student rapport scale predicts student outcomes. *Teaching of Psychology, 37*(4), 246251.

Wilson, J. H., & Ryan, R. G. (2012). Developing student-teacher rapport in the undergraduate classroom. In W. Buskist, V. A. Benassi, W. Buskist, V. A. Benassi (Eds.), *Effective college and university teaching: Strategies and tactics for the new professoriate* (pp. 81-89). Thousand Oaks, CA, US: Sage Publications, Inc.

Wilson, J. H., Wilson, S. B., & Legg, A. M. (2012). Building rapport in the classroom and student outcomes. In B. M. Schwartz, R. R. Gurung, B. M. Schwartz, R. R. Gurung (Eds.), *Evidence-based teaching for higher education* (pp. 23-37). Washington, DC, US: American Psychological Association. https://doi.org/10.1037/13745-002

Journal of Psychological Inquiry
2020, Vol.24, No. 2, pp. 17-23

IMPLICIT PRIMING REVEALS DECOMPOSED PROCESSING IN FRACTION COMPARISON

JESSICA A. NEJMAN AND THOMAS J. FAULKENBERRY
TARLETON STATE UNIVERSITY

Abstract – Fractions present a unique challenge in early mathematics instruction, as they require focusing not on the individual symbols that make up the fraction, but rather a mental combination of the two into a single numerical magnitude. Previous studies have given conflicting accounts of how adults form these complex mental representations. Whereas some studies indicate that mental representations of fractions are holistic and are based upon the fraction's numerical magnitude, others have indicated support for decomposed processing, where separate representations of the numerator and denominator are formed. In the present study, we tested this decomposed processing account using an implicit priming paradigm. In a series of experimental trials, the comparison of two fraction magnitudes ("which is larger?") primed a subsequent comparison trial with whole numbers. Using Bayesian analyses, we found that when people compared two fractions with common denominators, they were faster in the subsequent whole number comparison. However, when two fractions with common numerators were compared, the subsequent whole number comparison was slower. This indicates that representations of the fraction components were activated in the fraction comparison, and these residual activations primed the subsequent whole number comparison. These data give further support to the notion of decomposed processing in fraction comparison.

Keywords: fractions, decomposed processing, priming, Bayesian statistic

As a core part of American curriculum, mathematics is an area where students struggle. This is especially true for fraction and decimal operations, where difficulties persist from early high school (Hoffer, Venkataraman, Hedberg, & Shagle, 2007) and carry into adulthood (Kutner et al., 2007). Kutner et al. (2007) also demonstrated that almost a quarter of adults scored below basic level on simple judgements involving decimals and percentages. This rate of innumeracy has created questions about the cognitive underpinnings of fractions, as such knowledge would surely assist with developing more effective teaching of fractions during school. Since fractions contain multiple symbols which map to an overall numerical magnitude, it is not clear how children move from focusing on the individual symbols (i.e., the numerator and denominator) to mentally forming the ratio of the two numbers. So how do adults do this successfully? Unfortunately, there are relatively few studies which focus on how adults think about fractions, and these studies tend to present conflicting results.

Presently, the literature reveals two main types of fraction processing: holistic and decomposed (Faulkenberry & Pierce, 2011; Huber, Moeller, & Nuerk, 2014; Meert, Grégoire, & Noël, 2009; Obersteiner, Van Dooren, Van Hoof, & Verschaffel, 2013). Some studies suggest that adults use holistic processing in tasks involving fractions (Ganor-Stern, Karasik-Rivkin, & Tzelgov, 2011; Meert et al., 2009; Meert, Grégoire, & Noël, 2010; Obersteiner et al., 2013; Obersteiner & Tumpek, 2015; Schneider & Siegler, 2010). Holistic processing involves forming mental representations of fractions that involve the fraction's numerical magnitude as a ratio (i.e., ¼ = 0.25) rather than separately activating representations of the components of the fraction (i.e., the numerator 1 and denominator 4). Meanwhile, other studies indicate that fraction tasks are completed using decomposed processing (Bonato, Fabbri, Umilta & Zorzi, 2007; Faulkenberry & Pierce, 2011; Gabriel, Szücs, & Content, 2013; Huber et al., 2014; Zhang et al., 2011; Zhang, Fang, Gabriel, & Szücs, 2014; Faulkenberry, Montgomery, & Tennes, 2015), where separate mental representations are formed for the fraction's numerator and denominator.

In the majority of studies designed to investigate the nature of fraction representations, the primary task used is numerical comparison, where participants are presented with pairs of fractions and asked to quickly indicate which is the larger fraction. Researchers then investigate how the resulting response times differ as a function of the distance between the compared numbers. In one of the earliest studies on this topic, Bonato et al. (2007) found that response times were better predicted by the numerical distance between component magnitudes than the numerical distance between the

fraction magnitudes. From this, they concluded that their participants were using a decomposed, component-based strategy (i.e., comparing numerator to numerator or denominator to denominator), which allowed them to compare the fractions without having to access the numerical magnitude.

In a contrasting study, Schneider and Siegler (2010) demonstrated holistic processing of fractions. In their experiments, Schneider and Siegler varied the types of fraction stimuli that were presented and made it more difficult for participants to engage in component-based strategies. For example, instead of presenting fraction pairs that differed only in their denominators (e.g., 1/3 versus 1/5), Schneider and Siegler used fraction pairs where both components differed (e.g., 3/5 versus 2/9). The result was that numerical distance between the fractions (not the components themselves) was the best predictor of response times. Further, Faulkenberry and Pierce (2011) found that when participants were asked for strategy reports after every trial, there were a wide range of reported strategies, and the type of processing that was employed depended strongly on the nature of these strategies. For example, those who reported using cross-multiplication (a common strategy taught in US schools) exhibited signatures of component-based processing, whereas those who reported using mental visualization strategies (e.g., pizza or number line) exhibited holistic processing. As such, it is not clear whether fraction processing type is dependent on the fractions themselves, or rather on the comparison strategy used by the participant.

Whereas the previous studies used the presence of a numerical distance effect on response times to serve as a processing signature, Meert, Grégoire, and Noël (2009) took a fundamentally different approach. In their study, Meert et al. used implicit priming as a marker for fraction processing type. They presented participants with two interleaved tasks; every fraction comparison trial was followed immediately by a whole number comparison trial, where participants were asked to choose the larger of two whole numbers (e.g., 4 versus 8). Meert et al. found that when the presented whole numbers matched the fraction components from the previous trial, there was a significant priming effect. Specifically, when the fraction pair had the same denominator and the subsequent whole number trial used the same numerators as in the preceding fraction trial, the responses were faster compared to control trials. For example, consider the fraction pair 3/8 versus 5/8, from which a participant would choose 5/8 as the larger fraction. If the whole number pair 3 versus 5 was presented on the next trial (i.e., matching the numerators from the preceding fraction pair), participants tended to respond faster compared to conditions where the whole numbers did not match any of the earlier fraction components. Meert et al. (2009) conjectured that this facilitative priming effect was due to residual activation left over from directly comparing the numerators in the fraction pair.

On the other hand, when the fraction pair had the same numerator and the subsequent whole number trial used the same denominators as in the preceding fraction trial, the responses were slower compared to control trials. For example, consider the fraction pair 3/8 versus 3/5, from which a participant would choose 3/5 as the larger fraction. If the whole number pair 8 versus 5 was presented on the next trial -- matching the denominators from the preceding fraction pair -- participants tended to respond more *slowly* compared to conditions where the whole numbers did not match any of the earlier fraction components. For these trials, Meert et al. (2009) explained that this slowdown happened because participants had used a "smaller denominator = larger fraction" strategy on the earlier fraction pair. This strategy resulted in a residual activation of a representation "5 > 8", which needed to be inhibited in order to then correctly activate the correct representation "5 < 8" needed for the whole number comparison. This pattern of priming effects led Meert et al. (2009) to conclude that in all cases participants were forming representations of the fraction *components*, and these activated representations either facilitated or interfered (depending on fraction type) with the subsequent whole number comparison.

Since the original study of Meert et al. (2009), this implicit priming paradigm has seen little use in the mathematical cognition literature. The purpose of the present study was to replicate the work of Meert et al. (2009), with one methodological addition. If participants are engaging in decomposed processing (i.e., forming separate representations of fraction components), we expect to see similar priming signatures on the whole number comparison task. On the other hand, if participants are using purely holistic strategies, we should see no such priming effects on the subsequent whole number comparisons.

The methodological addition concerns how we index support for null effects. Meert et al. (2009) depended on the presence of a null effect to justify using one of their experimental conditions as a baseline for measuring priming effects. However, traditional hypothesis testing with *p*-values cannot be used as evidence for null effects (Wagenmakers, 2007; Masson, 2011). The reason for this is that absence of evidence for an effect is not equivalent to evidence for the absence of an effect (Wagenmakers, Verhagen, & Ly, 2016; Ly, Etz, Marsman, & Wagenmakers, 2019). Whereas a large *p*-value implies that an experimenter cannot reject the null (i.e., absence of evidence), this does not justify affirming that the null is true (i.e., evidence of absence). To circumvent this problem, we employed Bayesian hypothesis testing (Wagenmakers et al., 2017) in our analysis. Instead of indirectly gaining evidence for effects by rejecting a null hypothesis, the Bayesian approach

allows us to directly compute posterior probabilities (i.e., probabilities of hypotheses after observing data) of the null and/or alternative hypothesis for each test.

Method

Participants

Thirty-two undergraduate psychology students (29 female, mean age = 24.9 years, age range 18 to 58) participated in this experiment in exchange for partial course credit in their psychology courses. The experiment was reviewed and determined exempt by the Institutional Review Board at Tarleton State University.

Materials and Procedure

Participants were each presented with 256 numerical comparison trials. On each trial, participants were asked to choose the larger of two fractions or two whole numbers. The trials were paired in the sense that a fraction trial always preceded a corresponding whole number trial. Thus, there were 128 fraction comparison trials and 128 whole number comparison trials.

Fraction pairs were taken from the stimulus list of Meert et al. (2009). They consisted of 32 pairs of same numerator fractions and 32 pairs of same denominator fractions, each presented twice in counterbalanced order. To keep the fractions as similar as possible across fraction type, the components used as denominators in a pair of same numerator fractions would also be used as numerators in a pair of same denominator fractions. All of the fractions used were irreducible (i.e., had no common factors) and excluded the use of 10 as a denominator. All fractions were proper (i.e., numerical magnitude less than one), and the natural number components ranged from 2 to 19. The use of irreducible fractions in the experiment allowed control of variability due to the possibility of participants simplifying the fractions, which could possibly mask any numerical distance or priming effects. Each fraction pair group had the larger fraction presented on the left in half of the pairs and on the right in the other half.

Whole number pairs were constructed from the fraction pairs based on four different priming conditions, each of which resulted from crossing the variables of fraction type (same denominator, same numerator) and priming type (specific, nonspecific). Same denominator fractions had the form *a/x_b/x*; for example, 5/9 vs. 7/9. Same numerator fractions had the form *x/a_x/b*; for example, 2/7 vs. 2/3. For specific priming trials, the corresponding whole number task would use the *a* and *b* components of the preceding fraction trial (e.g., the numerators that were presented in the same denominator pairs or the denominators that were presented in the same numerator pairs). The whole numbers were presented in the same spatial arrangement as they were in the preceding fraction trial. For nonspecific priming trials, the whole number task would use different numbers from any that were presented in the preceding fraction comparison trial.

The experimental trials were presented on a 20" iMac using SuperLab 5 software. Participants were seated in front of the computer with a viewing distance of approximately 60 cm. Responses were indicated on a Cedrus RB-470 response pad, with the left-most button used to indicate that the left number was largest, whereas the right-most button was used to indicate that the right number was largest. The Cedrus response pad allowed us to record response times to approximately 2 ms accuracy. Stimuli were presented in white text on a black background. Each trial consisted of six components in the following order: (1) a fixation cross (+) presented in the center of the screen for 300 ms; (2) a blank screen presented for 500 ms; (3) a fraction pair; (4) a blank screen presented for 500 ms; (5) an integer pair; and (6) a blank screen presented for 1500 ms. For the numerical stimuli, participants were asked to indicate as quickly as possible the larger number from the pair presented on the screen. All number pairs were presented in the center of the screen and spanned a width of 13 cm (a horizontal visual angle of 12.4°). Fraction pairs spanned a height of 7 cm (a vertical visual angle of 7°), whereas integer pairs spanned a height of 2 cm (a vertical visual angle of 2°). Each experimental session was scheduled for 30 minutes; most participants needed only 15-20 minutes to complete all trials.

Results

Data Preparation

Participants completed a total of 8,192 experimental trials. Four participants had error rates near 50% on the fraction task, so we excluded their data from further analysis. For the whole number task, the remaining 28 participants each contributed 128 trials, giving us a total of 3,584 trials for analysis. Thirty errors (0.8% of trials) and 4 trials that exceeded 5,000 ms were excluded, leaving 3,554 trials for analysis. The response times from these trials were collapsed (via the median) into 112 design cells, resulting from crossing the factors of participant (N=28), fraction type (same denominator, same numerator), and priming type (specific, nonspecific).

Bayesian Hypothesis Testing

Since Meert et al. used *t*-tests in their original paper, we used the default Bayesian *t*-test (Rouder, Speckman, Sun, Morey, & Iverson, 2009; Faulkenberry, 2019a). The default Bayesian *t*-test works by first defining two competing hypotheses about effect size. Under the alternative hypothesis $\mathcal{H}_1$, the effect size is assumed to be distributed as a *Cauchy distribution*[1] with scale $1/\sqrt{2} = 0.707$ (Rouder et al., 2009). That is, we write

$$\mathcal{H}_1 : \delta \sim \text{Cauchy}\left(\tfrac{1}{\sqrt{2}}\right).$$

[1]The scale value $0.707 = 1/\sqrt{2}$ is recommended as a default because the resulting Bayes factor has a number of desirable properties; see Rouder et al., 2009, for details.

The Cauchy distribution is equivalent to a *t*-distribution with one degree of freedom. As such, the shape is similar to a normal distribution – i.e., peaked at 0 and symmetric – but the Cauchy distribution's tails are much fatter than those of the normal distribution. Our choice of prior and scale allows us to mathematically express our prior belief about the effect sizes we expect to observe in our experiment. Here, we would expect the most likely observed effect size to be 0, and 50% of the observed effect sizes should range between -0.707 and +0.707. Once we specify the prior distribution for effect sizes under $\mathcal{H}_1$, it is easy to define $\mathcal{H}_0$ by setting the effect size *equal* to 0:

$$\mathcal{H}_0 : \delta = 0 \, .$$

After making these prior specifications of $\mathcal{H}_1$ and $\mathcal{H}_0$, we are ready to confront these hypotheses with data and find out which one best predicts our observed data. The predictive adequacy of each hypothesis is tested using Bayes factors (Kass & Raftery, 1995). A Bayes factor -- denoted BF_{10} -- is defined as the relative likelihood of the observed data under the two hypotheses $\mathcal{H}_1$ and $\mathcal{H}_0$. For example, a Bayes factor of $BF_{10} = 8$ means that the observed data are 8 times more likely under the alternative hypothesis $\mathcal{H}_1$ than the null hypothesis $\mathcal{H}_0$. Similarly, $BF_{01} = 8$ would mean that the observed data are 8 times more likely under the null hypothesis $\mathcal{H}_0$ than the alternative hypothesis $\mathcal{H}_1$. Note that the Bayes factor is calculated as the ratio of marginal likelihoods of the observed data under each of these hypotheses. This means that the Bayesian *t*-test simultaneously assesses the adequacy of both $\mathcal{H}_0$ and $\mathcal{H}_1$ as predictive models of our observed data, something that a frequentist *t*-test does not do.

Bayes factors also quantify the factor by which the prior odds in favor of either $\mathcal{H}_0$ or $\mathcal{H}_1$ are changed after observing data, so it is straightforward to convert the Bayes factor to a posterior probability for either $\mathcal{H}_0$ or $\mathcal{H}_1$ (assuming $\mathcal{H}_0$ and $\mathcal{H}_1$ have equal prior odds; see Masson, 2011; Faulkenberry, 2019b). Specifically, if the Bayes factor tells us that the data are more likely under $\mathcal{H}_0$, we can compute

$$p(\mathcal{H}_0 \mid \text{data}) = \frac{\text{BF}_{01}}{1 + \text{BF}_{01}} .$$

On the other hand, if we find that the data are more likely under $\mathcal{H}_1$, we can compute

$$p(\mathcal{H}_1 \mid \text{data}) = \frac{\text{BF}_{10}}{1 + \text{BF}_{10}} .$$

All Bayes factors were computed using the free software package JASP (JASP Team, 2019; Marsman & Wagenmakers, 2018), freely downloadable from www.jasp-stats.org.

Response Time Analysis

Mean response times in the four experimental conditions can be seen in Figure 1, which follows the same general pattern found in Meert et al. (2009). Our first aim was to conduct a manipulation check and demonstrate that priming did occur in our experimental design; that is, when participants first compared two fractions, there was a priming effect in the subsequent whole number comparison trials in the specific priming condition, and critically, that there was a *null* priming effect in the nonspecific condition.

We found that in the specific priming condition, whole number comparisons that followed same denominator trials (M = 588 ms, SE = 25 ms) were faster than trials which following same numerator trials (M = 691 ms, SE = 39 ms). These data were overwhelmingly supportive of the alternative hypothesis predicting faster responses for same denominator trials than for same numerator trials, $BF_{10} = 503.0$. This Bayes factor indicates that the observed data are 503 times more likely under the alternative hypothesis than the null hypothesis. Assuming equal prior odds for $\mathcal{H}_0$ and $\mathcal{H}_1$, this is equivalent to a posterior probability of 0.998 in favor of the alternative hypothesis $\mathcal{H}_1$. However, for the nonspecific priming condition, we found no difference in response times between same denominator trials (M = 615 ms, SE = 30 ms) and same numerator trials (M = 631 ms, SE = 33 ms). The Bayes factor in favor of this null effect was $BF_{01} = 3.35$, indicating that the observed data were 3.35 times more likely under the null hypothesis than the alternative hypothesis. Assuming equal prior odds for $\mathcal{H}_0$ and $\mathcal{H}_1$, this converts to a posterior probability of 0.770 in favor of the null hypothesis $\mathcal{H}_0$. Thus, since whole number performance does not differ as a function of fraction type in nonspecific priming trials, it makes sense to use the nonspecific priming condition as a baseline for the specific priming effects.

Now we consider the effects of priming as a function of fraction type. To this end, we consider differences in response time between trials in the specific priming condition and trials in the baseline, nonspecific priming condition. For whole number comparisons primed by same denominator fraction comparisons, there was a speed-up compared to baseline (M = 615 ms for baseline versus M = 588 ms for primed trials). The Bayes factor for the alternative hypothesis predicting such a speedup was $BF_{10} = 2.84$; assuming equal prior odds for $\mathcal{H}_0$ and $\mathcal{H}_1$, this Bayes factor converts to a posterior probability of 0.740 in favor of the alternative hypothesis $\mathcal{H}_1$. On the other hand, whole number comparisons following same numerator trials showed the opposite pattern. When primed by same numerator fraction comparisons, participants' responses were slowed compared to baseline (M = 691 ms for primed trials compared to M = 631 ms for baseline). The Bayes factor in favor of the alternative hypothesis predicting this slowdown was $BF_{10} = 298.1$, which converts to a posterior probability of 0.997 in favor of the alternative hypothesis $\mathcal{H}_1$.

In summary, we found positive evidence for the priming effects described by Meert et al. (2009). Same denominator fraction comparisons tended to speed up subsequent whole number comparisons, whereas same numerator fraction comparisons tended to slow down the subsequent whole number comparisons. This would only be possible if participants were forming representations of the individual fraction components, and these activations were carried downstream into the whole number comparison. Thus, our results lend further support to the idea that fraction comparisons involve decomposed processing.

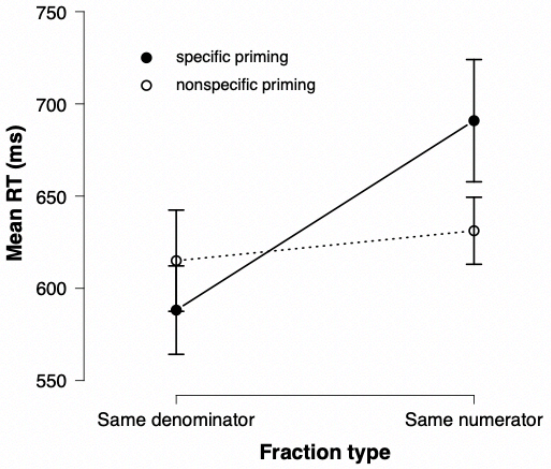


Figure 1. Mean response times on the whole number comparison task as a function of fraction type (same denominator, same numerator) and priming type (specific, nonspecific). Error bars represent within-subject 95% confidence intervals as recommended by Morey (2008).

Discussion

The purpose of the present study was to investigate the mental representations formed when people think about fractions. Specifically, we aimed to test whether participants formed decomposed representations of fractions (i.e., whether they formed representations of numerators and/or denominators) when engaged in a fraction comparison task. To do this, we used the implicit priming paradigm first applied by Meert et al. (2009), who found that when whole number comparisons immediately followed fraction comparisons with the same two numbers in the numerators, there was a speed-up over baseline in the whole number task. However, when the fraction comparison involved the same two numbers in the denominators, there was a slowdown in the whole number task. From this, Meert et al. (2009) concluded that participants were forming separate representations of the components in the fractions that either facilitated or interfered with the subsequent whole number task. That is, participants exhibited decomposed processing with fractions.

In our replication of Meert et al. (2009), we found roughly the same results. First, we demonstrated that the implicit priming paradigm does indeed work in the context of mathematical cognition. That is, in the specific priming condition, where the to-be-compared components of the fraction pair exactly matched the two numbers that were compared in the subsequent whole number comparison, there was a marked difference in response times between fraction types. However, in the nonspecific priming conditions, where there was no such match between the fraction components and the subsequent whole number comparison, there was no difference in response times between fraction types. We used Bayesian inference to confirm this null effect, which extends what Meert et al. (2009) were able to conclude from their original, purely frequentist analyses.

After confirming that response times for nonspecific priming trials did not differ between fraction types, we were able to confirm the predictions of Meert et al. (2009) regarding the specific direction of the priming effects. Specifically, in same denominator trials, there was a relative speed-up in the subsequent whole number comparison. This reflects a facilitation effect; if participants are forming decomposed representations of the numerators in the fraction pair, the residual activation of these numerators then facilitates the comparison of the whole numbers in the very next trial. On the other hand, in same numerator trials, the opposite pattern occurs. In these fraction pairs, the nature of the task is different. For example, consider the pair 2/7 versus 2/5. If participants are forming decomposed representations of the 7 and the 5 in the denominators, the context of fraction comparison dictates that participants should adopt a "smaller is bigger" strategy and conclude that the fraction with the smaller denominator (2/5) is the larger fraction (Faulkenberry & Pierce, 2011). This results in an inhibitory effect on the subsequent whole number comparison. In whole number comparison, the comparison strategy will be opposite to what was employed for the fractions. Thus, any residual activation from the representation of the denominators 5 and 7 will have to decay before the participant can correctly judge that 7 is greater than 5 in a whole number context. The result is that we observe increased response times in the whole number comparison task (relative to baseline).

In all, these data lend support to models of fraction representation which hypothesize decomposed processing of fractions (e.g., Bonato et al., 2007; Faulkenberry & Pierce, 2011; Faulkenberry et al., 2015). More broadly, this research fits in with similar studies of holistic versus decomposed processing in other numerical contexts, including two-digit number comparison (e.g., Verguts & De Moor, 2005; Nuerk, Weger, & Willmes, 2001; Faulkenberry, Cruise, & Shaki, 2020). Further, we demonstrated the pragmatic advantages of Bayesian inference as a tool for assessing null effects in

psychological research. In future work, we hope to further elucidate the nature of fraction representations in more broadly defined contexts, such as using more complex fractions (e.g., 13/24) or embedding fractions in word problems (e.g., one part out of five). In addition, it will be interesting to investigate the implicit priming paradigm as a tool for testing theories in mathematical cognition, potentially validating its use as a measurement tool for indexing individual differences in mathematical skill.

References

Bonato, M., Fabbri, S., Umiltà, C., & Zorzi, M. (2007). The mental representation of numerical fractions: Real or integer? *Journal of Experimental Psychology: Human Perception and Performance, 33*(6), 1410–1419. doi:10.1037/0096-1523.33.6.1410

Faulkenberry, T. J. (2019a). A tutorial on generalizing the default Bayesian t-test via posterior sampling and encompassing priors. *Communications for Statistical Applications and Methods, 26*(2), 217–238. doi:10.29220/csam.2019.26.2.217

Faulkenberry, T. J. (2019b). Estimating evidential value from ANOVA summaries: A comment on Ly et al. (2018). *Advances in Methods and Practices in Psychological Science, 2*(4), 406-409. doi: 10.1177/2515245919872960

Faulkenberry, T. J., Cruise, A., & Shaki, S. (2020). Task instructions modulate unit-decade binding in two-digit number representation. *Psychological Research, 84*(2), 424-439. doi:10.1007/s00426-018-1057-9

Faulkenberry, T. J., Montgomery, S. A., & Tennes, S.-A. N. (2015). Response trajectories reveal the temporal dynamics of fraction representations. *Acta Psychologica, 159*, 100–107. doi:10.1016/j.actpsy.2015.05.013

Faulkenberry, T. J., & Pierce, B. H. (2011). Mental representations in fraction comparison: Holistic versus component-based strategies. *Experimental Psychology, 58*(6), 480–489. doi:10.1027/1618-3169/a000116

Gabriel, F., Szücs, D., & Content, A. (2013). The mental representations of fractions: Adults' same-different judgments. *Frontiers in Psychology, 4*, 385. doi:10.3389/fpsyg.2013.00385

Ganor-Stern, D., Karasik-Rivkin, I., & Tzelgov, J. (2011). Holistic representation of unit fractions. *Experimental Psychology, 58*(3), 201–206. doi:10.1027/1618-3169/a000086

Hoffer, T. B., Venkataraman, L, Hedberg, E. C., & Shagle, S. (2007). *Final Report on the National Survey of Algebra Teachers for the National Math Panel*. Chicago: National Opinion Research Center at the University of Chicago.

Huber, S., Moeller, K., & Nuerk, H.-C. (2014). Adaptive processing of fractions: Evidence from eye-tracking. *Acta Psychologica, 148*, 37–48. doi:10.1016/j.actpsy.2013.12.010

JASP Team (2019). JASP (Version 0.11.1) [Computer software].

Kass, R. E., & Raftery, A. E. (1995). Bayes Factors. *Journal of the American Statistical Association, 90*(430), 773-795. doi:10.2307/2291091

Kutner, M., Greenberg, E., Jin, Y., Boyle, B., Hsu, Y., Dunleavy, E., et al. (2007). *Literacy in everyday life: Results from the 2003 National Assessment of Adult Literacy*. NCES 2007-480. Retrieved from http://nces.ed.gov/Pubs2007/2007480.pdf.

Ly, A., Etz, A., Marsman, M., & Wagenmakers, E.-J. (2019). Replication Bayes factors from evidence updating. *Behavior Research Methods,* 51, 2498–2508. doi:10.3758/s13428-018-1092-x

Marsman, M., & Wagenmakers, E.-J. (2016). Bayesian benefits with JASP. European Journal of *Developmental Psychology, 14*(5), 545–555. doi:10.1080/17405629.2016.1259614

Masson, M. E. J. (2011). A tutorial on a practical Bayesian alternative to null-hypothesis significance testing. *Behavior Research Methods, 43*(3), 679–690. doi:10.3758/s13428-010-0049-5

Meert, G., Grégoire, J., & Noël, M.-P. (2009). Rational numbers: Componential versus holistic representation of fractions in a magnitude comparison task. *The Quarterly Journal of Experimental Psychology, 62*(8), 1598–1616. doi:10.1080/17470210802511162

Meert, G., Grégoire, J., & Noël, M.-P. (2010). Comparing 5/7 and 2/9: Adults can do it by accessing the magnitude of the whole fractions. *Acta Psychologica, 135*(3), 284–292. doi:10.1016/j.actpsy.2010.07.014

Morey, R. D. (2008). Confidence intervals from normalized data: A correction to Cousineau (2005). *Tutorials in Quantitative Methods for Psychology, 4*(2), 61–64. doi:10.20982/tqmp.04.2.p061

Nuerk, H.-C., Weger, U., & Willmes, K. (2001). Decade breaks in the mental number line? Putting the tens and units back in different bins. *Cognition, 82*(1), B25-B33. doi:10.1016/s0010-0277(01)00142-1

Obersteiner, A., & Tumpek, C. (2015). Measuring fraction comparison strategies with eye-tracking. *ZDM Mathematics Education*. doi:10.1007/s11858-015-0742-z

Obersteiner, A., Van Dooren, W., Van Hoof, J., & Verschaffel, L. (2013). The natural number bias and magnitude representation in fraction comparison by expert mathematicians. *Learning*

and Instruction, 28, 64–72. doi:10.1016/j.learninstruc.2013.05.003

Rouder, J. N., Speckman, P. L., Sun, D., Morey, R. D., & Iverson, G. (2009). Bayesian t tests for accepting and rejecting the null hypothesis. *Psychonomic Bulletin & Review, 16*(2), 225–237. doi:10.3758/pbr.16.2.225

Schneider, M., & Siegler, R. S. (2010). Representations of the magnitudes of fractions. *Journal of Experimental Psychology: Human Perception and Performance, 36*(5), 1227–1238. https://doi.org/10.1037/a0018170

Verguts, T., & De Moor, W. (2005). Two-digit comparison: Holistic, decomposed, or hybrid. *Experimental Psychology, 52*(3), 195-200. doi: 10.1027/1618-3169.52.3.195

Wagenmakers, E.-J. (2007). A practical solution to the pervasive problems ofp values. *Psychonomic Bulletin & Review, 14*(5), 779–804. doi:10.3758/bf03194105

Wagenmakers, E.-J., Marsman, M., Jamil, T., Ly, A., Verhagen, J., Love, J., … Morey, R. D. (2017). Bayesian inference for psychology. Part I: Theoretical advantages and practical ramifications. *Psychonomic Bulletin & Review, 25*(1), 35–57. doi:10.3758/s13423-017-1343-3

Wagenmakers, E.-J., Verhagen, J., & Ly, A. (2016). How to quantify the evidence for the absence of a correlation. *Behavior Research Methods, 48*(2), 413–426. doi:10.3758/s13428-015-0593-0

Zhang, L., Fang, Q., Gabriel, F. C., & Szücs, D. (2014). The componential processing of fractions in adults and children: Effects of stimuli variability and contextual interference. *Frontiers in Psychology, 5*. doi:10.3389/fpsyg.2014.00981

Zhang, L., Xin, Z., Li, F., Wang, Q., Ding, C., & Li, H. (2011). An ERP study on the processing of common fractions. *Experimental Brain Research, 217*(1), 25–34. doi:10.1007/s00221-011-2969-4

Author Note

This research was supported in part by funding from the Tarleton State University Office of Student Research and Creative Activities. The results presented in this manuscript were previously presented at a meeting of the Southwestern Psychological Association.

Correspondence concerning this article should be addressed to Thomas J. Faulkenberry, Department of Psychological Sciences, Tarleton State University, Box T-0820, Stephenville, TX 76402. Phone: +1 (254) 968-9816. Email: faulkenberry@tarleton.edu

Journal of Psychological Inquiry
2020, Vol.24, No. 2, pp. 24-29

ADULTS' ATTITUDES TOWARD BLACK AND WHITE UNDERGRADUATES WHO RECEIVE ACADEMIC ACCOMMODATIONS

KENNEDY A. SCHMITT, TUCKER L. JONES, AND MARK A. BARNETT
KANSAS STATE UNIVERSITY

Abstract – The present study explored whether adults' attitudes toward undergraduates who receive academic accommodations are influenced by the undergraduates' race. The participants' (N = 226; M_{age} = 35.06 years) responses to the attitude questionnaire reflected different beliefs about why Black and White undergraduates receive academic accommodations. Specifically, the participants agreed more strongly that (1) a White than a Black male student's need for academic accommodations is the result of a biological flaw (i.e., "something wrong within his body or brain") and (2) Black than White students who receive academic accommodations have a relatively poor educational background. In addition, the participants indicated that when instructors provide academic accommodations to a Black student, they feel more compelled to do so by university requirements than when they provide accommodations to a White student. Taken together, these findings provide insight into the biased perceptions some adults may have when evaluating Black and White undergraduates who have been provided with academic accommodations.

Keywords: academic accommodations, attitudes, race

Research has demonstrated that individuals tend to have negative attitudes toward others who they perceive as having an undesirable characteristic or as being deviant or deficient in some manner (e.g., Chan, McMahon, Cheing, Rosenthal, & Bezyak, 2005; Lebowitz, 2016; Puhl & Lattner, 2007). For example, May and Stone (2010) demonstrated that undergraduates tend to have negative attitudes toward peers with a learning disability who receive academic accommodations (e.g., a notetaker, a distraction-free environment for taking exams, and extra time on exams). More specifically, May and Stone (2010) found that undergraduates who receive academic accommodations due to a learning disability tend to be perceived by their peers as taking advantage of the system, having relatively low ability, and being less intelligent than other students. Similarly, Egan and Giuliano (2009) found that many undergraduates believe that academic accommodations given to students with a learning disability lower the course requirements for these students and, therefore, give them an unfair advantage over other classmates. In a related study addressing the topic of accommodations outside the classroom, Dowrick, Anderson, Heyer, and Acosta (2005) found that adult employees tend to have negative perceptions of co-workers who have a learning disability and receive accommodations at work.

In another domain involving unfavorable responses to others, the negative stereotyping and prejudice often directed toward Black individuals within our society have been found to extend into the elementary (Goyer et al., 2019; Okonofua, Walton, & Eberhardt, 2016; Skiba et al., 2011) and college classroom (e.g., Suarez-Balcazar, Orellana-Damacela, Portillo, Rowan, & Andrews-Guillen, 2003**)**. In the Suarez-Balcazar et al. (2003) study, for example, Black college students were found to be (a) racially stereotyped by both teachers and classmates and (b) treated differently (e.g., ignored more frequently) than other students.

Although prior research has demonstrated that individuals tend to respond relatively unfavorably toward students who receive academic accommodations as well as those who are Black, no study to date has addressed if a Black undergraduate who receives academic accommodations is perceived differently or evaluated more negatively than a White undergraduate who receives the identical accommodations. This gap in the literature provided the basis for this exploratory study.

Overview of Present Study

In the present study, adult participants were presented with a profile of a (hypothetical) Black or White undergraduate who has been a consistent recipient of three academic accommodations as mandated by the Academic Support Center at the undergraduate's university (see Method and Appendix A).[1] After reviewing the profile of one of the students, the participants rated the extent to which they disagreed or agreed with 13 statements designed to assess a broad range of attitudes toward the student and his (her) use of the accommodations (see Method below and Appendix B). Because the participants' responses to the individual statements on the attitude questionnaire (rather than the total score on the questionnaire) constituted the critical dependent variables in the present study, the origin and

[1]Although the primary focus of the current investigation was on adults' attitudes toward Black and White undergraduates who receive academic accommodations, the gender of the undergraduate targets was also incorporated in the design of the study to allow for the exploration of potential Race of Target × Gender of Target interactions in the participants' ratings.

purpose of the various statements on the questionnaire merit attention.

Six of the statements on the attitude questionnaire were adapted from prior studies of children's and adults' attitudes toward individuals with an undesirable characteristic (e.g., being extremely overweight) unrelated to requiring academic accommodations (Barnett, Livengood, Sonnentag, Barlett, & Witham, 2010; Barnett, Sonnentag, Livengood, Struble, & Wadian, 2011; Barnett, Sonnentag, Wadian, Jones, & Langley, 2015; Barnett, Wadian, Sonnentag, & Nichols, 2015). Three of these statements ("It is this student's own fault that he [she] needs to be provided with academic accommodations in all of his [her] classes."; "It is this student's parents' fault that he [she] needs to be provided with academic accommodations in all of his [her] classes."; "The reason this student needs to be provided with academic accommodations in all of his [her] classes is that there is something wrong within his [her] body or brain.") assessed the participants' attributions concerning the reason why a particular undergraduate was granted academic accommodations. These statements were included on the questionnaire because prior attribution research (e.g., Kelley and Michela, 1980; Weiner, 1980, 1986, 1995) has demonstrated that individuals who are perceived as personally responsible for their unfortunate personal circumstance due to laziness or negligence (an *internal attribution*) tend to be devalued, treated relatively harshly, and considered unworthy recipients of helping behaviors, whereas individuals whose unfortunate personal circumstance is attributed to factors largely out of their control (an *external attribution*) tend to be perceived and treated relatively more favorably. Three of the other statements on the attitude questionnaire that were adapted from prior studies (Barnett et al., 2010; Barnett et al., 2011; Barnett, Sonnentag et al., 2015; Barnett, Wadian et al., 2015) tapped participants' attitudes toward the Black or White undergraduate's desire to succeed academically ("This student wants to do well in all of his [her] classes."), effort to succeed academically ("This student tries to do well in all of his [her] classes."), and attainment of success academically (This student does well [i.e., receives final grades of As or Bs] in most of his [her] classes.).

The remaining seven statements on the attitude questionnaire were written specifically for the present study to assess participants' attitudes toward a broad range of issues associated with the Black and White undergraduates who receive academic accommodations. Three of these statements encouraged the participants to compare their beliefs about undergraduates who receive accommodations with their beliefs about "most of the other students at his (her) university." Finally, four of the statements tapped the participants' beliefs about the Black and White undergraduates' motivation for receiving accommodations, the genuineness of their need for accommodations, the fairness to other students that they receive accommodations, and their instructors' presumed opinion about the university requirement that they provide accommodations to these students.

Because of the exploratory nature of the present study, no specific Race of Target main effect predictions (or Race of Target × Gender of Target interaction predictions) were made concerning the participants' ratings in response to the 13 statements on the attitude questionnaire.

Method

Participants

A total of 226 individuals (109 males, 117 females) between the ages of 19 and 79 (M_{age} = 35.06; SD_{age} = 11.17) were recruited via Amazon's Mechanical Turk (MTurk).[2] Of the 226 participants, 169 (74.78%) identified themselves as Caucasian/White, 17 (7.52%) identified themselves as African-American/Black, and 40 (17.70%) identified themselves as Hispanic, Asian/Pacific Islander, Native American, or other. In response to an inquiry about each participants' highest level of education attained, 154 (68.14%) reported having at least a bachelor's degree, 22 (9.73%) reported having an associate's degree, 8 (3.54%) reported having a post-secondary vocational certificate, 41 (18.14%) reported having a high school diploma, and 1 (0.44%) reported that he did not complete high school.

Materials and Procedure

After completing a brief demographics questionnaire, each participant was presented with a profile of a (hypothetical) undergraduate who was described as being provided with academic accommodations as mandated by his (her) university's Academic Support Center (see Appendix A). The male or female student was presented as either Black or White. In each of the four randomly assigned conditions (i.e., Black male, White male, Black female, White female), the participants were provided with (a) a photograph of the named student,[3] (b) the student's age (i.e., 20 years old)

[2]For a discussion of the increasing use of MTurk samples in social and personality psychology research, see Anderson et al. (2019).

[3]The photographs of the four individuals who were used in the present study (see Appendix A) were selected from those available at www.faceresearch.org. We are grateful to the researchers (DeBruine, 2016; DeBruine & Jones, n.d.) for granting us permission to use these photographs from their website in the present study. Data provided on the DeBruine and Jones website indicate that all four targets used in the present study have been rated as moderately attractive (*M*s ranging from 3.26 to 4.29 on a scale from 1 [*much less attractive than average*] to 7 [*much more attractive than average*]) by a sample of individuals ranging from 17 to 90 years of age. The names of the Black male undergraduate (i.e., Jamal) and Black female undergraduate (i.e., Jada) were selected for use in the present study because they are relatively common African-American names that have been used in prior research to depict hypothetical Black individuals (Levitt & Dubner, 2005; Wadian & Barnett, 2018).

and year in school (i.e., junior), and (c) a description of the three academic accommodations he (she) receives in each of his (her) classes (i.e., a notetaker, a distraction-free environment for taking exams, and extra time on exams).

After reviewing the profile of one of the four students, the participants rated on a 6-point scale ranging from 1 (*disagree a lot*) to 6 (*agree a lot*) the extent to which they disagreed or agreed with 13 statements designed to assess a broad range of attitudes toward the student and his (her) use of the academic accommodations (see Appendix B). Participants' responses to the statements on the questionnaire were scored such that higher scores reflected a more negative attitude toward the target or his (her) use of the accommodations; therefore, responses to statements 3, 11, 12, and 13 on the questionnaire were reverse scored. Using the same 6-point scale as the attitude measure, the participants also rated the extent to which they disagreed or agreed with 13 statements on a social desirability measure adapted from Reynolds (1982; $\alpha = .81$ in the present study), with higher total scores reflecting a participant's greater tendency to respond in a socially desirable manner. After the participants completed the social desirability measure, they were debriefed and thanked for taking part in the study.

Results

A series of 2 (Race of Target: Black vs. White) × 2 (Gender of Target: Male vs. Female) ANCOVAs, controlling for the participants' social desirability scores, revealed significant findings for three of the 13 statements included on the attitude questionnaire.

First, a significant Race of Target × Gender of Target interaction was found for the participants' responses to the statement, "The reason this student needs to be provided with academic accommodations in all of his (her) classes is that there is something wrong within his (her) body or brain," $F(1, 221) = 4.67$, $p = .03$, $\eta^2 = .02$. A simple effects post hoc test revealed that the participants agreed more strongly with this statement when considering the White male student (adjusted $M = 3.94$, $SE = 0.21$) than when considering the Black male student (adjusted $M = 3.27$, $SE = 0.19$), $F(1, 221) = 5.65$, $p = .02$. The "body or brain" ratings of the White female student (adjusted $M = 3.81$, $SE = 0.20$) and the Black female student (adjusted $M = 4.00$, $SE = 0.19$) did not differ, $F(1, 221) = 0.45$, $p = .50$.

Second, there was a significant main effect of Race of Target concerning the students' presumed educational background, $F(1, 221) = 9.74$, $p = .002$, $\eta^2 = .04$. Specifically, the participants agreed more strongly with the statement, "This student probably has a poorer educational background than most of the other students at his (her) university," when considering a Black student with academic accommodations (adjusted $M = 3.63$, $SE = 0.14$) than a White student with academic accommodations (adjusted $M = 3.00$; $SE = 0.15$).

Third, there was also a significant main effect of Race of Target concerning the presumed willingness of the students' instructors to provide the academic accommodations to the students, $F(1, 221) = 4.20$, $p = .04$, $\eta^2 = .02$. Specifically, the participants agreed more strongly with the statement, "If this student's instructors were not required by the university to provide academic accommodations to him (her), they would not do so," when considering a Black student (adjusted $M = 4.29$; $SE = 0.12$) than when considering a White student (adjusted $M = 3.94$; $SE = 0.12$).

Discussion

The "good news" associated with the results of the present study is that for 10 of the 13 statements included on the attitude questionnaire, no significant main or interaction effects involving the race of the target were found. For example, the adult participants did not differ in the extent to which they agreed that Black and White undergraduates provided with academic accommodations desire to do well in their classes, exert effort to do well in their classes, and earn good grades in most of their classes. However, the three statements that yielded significant effects involving the race of the target provide some insight into the biased perceptions the participants had when they considered Black and White undergraduates provided with academic accommodations.

The participants' responses to two of the statements on the attitude questionnaire reflected somewhat different attributions about why the Black and White undergraduates are granted academic accommodations. First, the participants agreed more strongly that the White than the Black male student's need for academic accommodations is the result of "something wrong within his body or brain." Given that a biological flaw (e.g., a biochemical or brain abnormality) is typically perceived as something that is out of an individual's personal control, the participants appear to have agreed more strongly with an external attribution for the White male's than the Black male's need for accommodations. Second, the participants agreed more strongly that the Black than the White students who receive academic accommodations have a relatively poor educational background which, presumably, leaves the Black students relatively unprepared to meet the demands of the university classroom without special assistance. In contrast to the external attribution that a biological flaw is the reason that a student needs academic accommodations, it is unclear the extent to which a relatively poor educational background reflects an external attribution (e.g., being placed in poorly funded and poorly run elementary and secondary schools) or an internal attribution (e.g., the student's

relative lack of effort while attending elementary and secondary schools).

As an exemplar of "projected" racial bias, the participants indicated that when instructors provide academic accommodations to a Black student, they feel more compelled to do so by university requirements than when they provide academic accommodations to a White student. This finding suggests that the participants may believe that instructors (a) feel that Black students are less deserving of academic accommodations than are White students (perhaps, because the Black students' academic challenges are attributed to a relatively poor educational background rather than a learning disability, per se), (b) are more motivated to assist White than Black students by providing academic accommodations, or (c) feel that Black students are less likely to benefit from academic accommodations than are White students. Regardless of which of these three interpretations is found to be most accurate in future research, all of them would appear to reflect a relatively unfavorable attitude toward providing academic accommodations to Black students.

Limitations and Future Research

One limitation of the present study involves the racial/ethnic composition of our sample. Given that a large majority of the sample identified themselves as Caucasian/White, we were unable to assess whether the significant (as well as the non-significant) Race of Target findings obscured differences in the attitudes among the various racial/ethnic subgroups toward Black and White undergraduates provided with academic accommodations. Future research incorporating a larger and more diverse sample of participants (and targets) will help to determine the extent to which specific attitudes toward undergraduates receiving academic accommodations are influenced by the race/ethnicity of the participant as well as the race/ethnicity of the student receiving the accommodations.

A second limitation of the present study was the use of the participants' responses to the 13 individual statements on the attitude questionnaire as the critical dependent variables in the present study. Although six of these statements were adapted from prior studies that have been used to assess participants' attitudes toward individuals with an undesirable characteristic (Barnett et al., 2010; Barnett et al., 2011; Barnett, Sonnentag et al., 2015; Barnett, Wadian et al., 2015), the problems inherent in establishing the reliability and validity of any single-item measure are always a legitimate concern. Future research, using multiple-item measures that have an established track record of psychometric soundness should be used in subsequent attempts to replicate and extend the present findings.

The most striking finding in the present study involved the participants' belief that university instructors are racially biased in their willingness to provide academic accommodations to Black and White undergraduates. Future research, conducted in more naturalistic settings, should address the factors (including the race/ethnicity of the student and the student's instructors) that influence instructors' attitudes toward students who receive academic accommodations as well as the mandate that requires them to provide those accommodations.

References

Anderson, C. A., Allen, J. J., Plante, C., Quigley-McBride, A., Lovett, A., & Rokkum, J. N. (2019). The MTurkification of social and personality psychology. *Personality and Social Psychology Bulletin, 45*, 842-850. doi: 10.1177/0146167218798821

Barnett, M. A., Livengood, J. L., Sonnentag, T. L., Barlett, N. D., & Witham, R. Y. (2010). Children's anticipated responses to hypothetical peers with undesirable characteristics: Role of peers' desire to change, effort to change, and outcome. *Journal of Genetic Psychology, 171*, 262-269. doi: 10.1080/00221325.2010.492815

Barnett, M. A., Sonnentag, T. L., Livengood, J. L., Struble, A. L., & Wadian, T. W. (2011). Role of fault attributions and desire, effort, outcome expectations in children's anticipated responses to hypothetical peers with various undesirable characteristics. *Journal of Genetic Psychology, 173,* 317-329. doi: 10.1080/00221325.2011.610391

Barnett, M. A., Sonnentag, T. L., Wadian, T. W., Jones, T. L., & Langley, C. A. (2015). Children's perceptions of hypothetical peers with undesirable characteristics: Role of the peers' desire to change, source of effort to change, and outcome. *Journal of Genetic Psychology, 176*, 55-63. doi: 10.1080/00221325.2014.1002751

Barnett, M. A., Wadian, T. W., Sonnentag, T. L., & Nichols, M. B. (2015). Role of various fault attributions and other factors in children's anticipated response to hypothetical peers with undesirable characteristics. *Social Development, 24*, 113-127. doi: 10.1111/sode.12087

Chan, F., McMahon, B. T., Cheing, G., Rosenthal, D. A., & Bezyak, J. (2005). Drivers of workplace discrimination against people with disabilities: The utility of attribution theory. *Work: Journal of Prevention, Assessment & Rehabilitation, 25*, 77-88.

DeBruine, L. (2016). Young adult composite faces. figshare. doi: 10.6084/m9.figshare.4055130.v1

DeBruine, L., & Jones, B. (n.d.). Face research ⇒ Experiments about face and voice perception. Retrieved April 24, 2018, from http://www.faceresearch.org/.

Dowrick, P. W., Anderson, J., Heyer, K., & Acosta, J. (2005). Postsecondary education across the USA: Experiences of adults with disabilities. *Journal of Vocational Rehabilitation, 22*, 41-47.

Egan, P. M., & Giuliano, T. A. (2009). Unaccommodating attitudes: Perceptions of students as a function of academic accommodation use and test performance. *North American Journal of Psychology, 11*, 487-500.

Goyer, J. P., Cohen, G. L., Cook, J. E., Master, A., Apfel, N., Lee, W., . . . Walton, G. M. (2019). Targeted identity-safety interventions cause lasting reductions in discipline citations among negatively stereotyped boys. *Journal of Personality and Social Psychology, 117*, 229-259. doi: 10.1037/pspa0000152

Kelley, H. H., & Michela, J. L. (1980). Attribution theory and research. *Annual Review of Psychology, 31*, 457-501. doi: 10.1146/annurev.ps.31.020180.002325

Lebowitz, M. S. (2016). Stigmatization of ADHD: A developmental review. *Journal of Attention Disorders, 20*, 199-205. doi: 10.1177/1087054712475211

Levitt, S., & Dubner, S. J. (2005). *Freakonomics: A rogue economist explores the hidden side of everything*. New York: William Morrow.

May, A. L., & Stone, C. A. (2010). Stereotypes of individuals with learning disabilities: Views of college students with and without learning disabilities. *Journal of Learning Disabilities, 43*, 483-499. doi: 10.1177/0022219409355483

Okonofua, J. A., Walton, G. M., & Eberhardt, J. L. (2016). A vicious cycle: A social-psychological account of extreme racial disparities in school discipline. *Perspectives on Psychological Science, 11*, 381-398. doi: 10.1177/1745691616635592

Puhl, R. M., & Latner, J. D. (2007). Stigma, obesity, and the health of the nation's children. *Psychological Bulletin, 133*, 557-580. doi: 10.1037/0033-2909.133.4.557

Reynolds, W. M. (1982). Development of reliable and valid short forms of the Marlowe-Crowne social desirability scale. *Journal of Clinical Psychology 38*, 119-125. doi: 10.1002/1097-4679(198201)38:1 3.0.CO;2-I

Skiba, R. J., Horner, R. H., Chung, C., Rausch, M. K., May, S. L., & Tobin, T. (2011). Race is not neutral: A national investigation of African American and Latino disproportionality in school discipline. *School Psychology Review, 40*, 85-107.

Suarez-Balcazar, Y., Orellana-Damacela, L., Portillo, N., Rowan, J. M., & Andrews-Guillen, C. (2003). Experiences of differential treatment among college students of color. *The Journal of Higher Education, 74*, 428-444. doi: 10.1080/00221546.2003.11780855

Wadian, T. W., & Barnett, M. A. (2018, April). Reducing children's prejudice through a personalized storybook intervention. Poster presented at the annual meeting of the Midwestern Psychological Association, Chicago, IL.

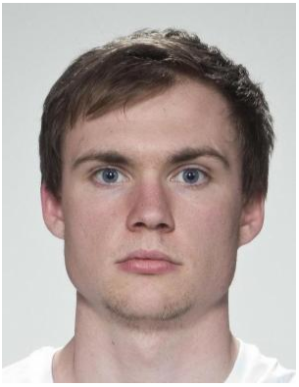
Weiner, B. (1980). A cognitive (attribution)-emotion-action model of motivated behavior: An analysis of judgments of help-giving. *Journal of Personality and Social Psychology, 39*, 186-200. doi: 10.1037/0022-3514.39.2.186

Weiner, B. (1986). *An attributional theory of motivation and emotion*. New York: Springer-Verlag. doi: 10.1007/978-1-4612-4948-1

Weiner, B. (1995). *Judgments of responsibility: A foundation for a theory of social conduct*. New York, NY: Guilford Press.

Appendix A

Information Presented to Participants from a (Hypothetical) Student's Academic Support Center Portfolio: White Male Condition



Portfolio Information: Jimmy is a 20-year-old junior attending a university in the Midwest. Beginning in the first semester of his freshman year, the Academic Support Center at Jimmy's university has determined that he is eligible to receive academic accommodations in all of his classes. Since his freshman year, Jimmy's instructors have provided him with the following three academic accommodations:

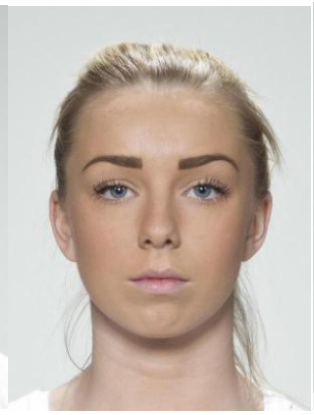
Notetaker: Jimmy has a classmate take all of the lecture notes for him on a laptop, and the classmate emails those notes to him within 24 hours of the completion of each class session.

Distraction-Free Environment for Taking Exams: Jimmy is allowed to take all of the course examinations alone with a proctor in a special room that is designed to have minimal distractions. This special room is located in the Testing Center in the Academic Support Center at Jimmy's university.

Extra Time on Exams: Jimmy is allowed up to 90 minutes additional time to complete all examinations

Photos and Names Presented to Participants in the Black Male, White Female, and Black Female Conditions

Jamal



Jennifer

Jada

Journal of Psychological Inquiry
2020, Vol.24, No. 2, pp. 30-36

THE INFLUENCE OF WHITE PRIVILEGE ON RACIAL MICROAGGRESSIONS

JORDAN SPARROW AND WHITNEY K. WHITAKER
FORT HAYS STATE UNIVERSITY

Abstract – Previous research has examined the detrimental impact of racial microaggressions experienced by minority group members; however, little is known regarding the perspective of majority group members who may utilize racial microaggressions. The current work examined the agreement of racial microaggressions (i.e., levels of agreement regarding the derogatory message(s) communicated) and thoughts and actions considered to be racial microaggressions from a majority group (i.e., White) perspective. White privilege also was examined as a factor related to the thoughts/actions and agreement of racial microaggressions. Undergraduate students (N=70) completed self-report measures assessing White privilege attitudes, the frequency of racial microaggression thoughts and actions, and the level of agreement with the underlying messages that racial microaggressions communicate. Results indicated that the awareness of White privilege was a significant predictor of the agreement underlying the communicated message of racial microaggressions as being negative and derogatory. Further, when participants reported more cost(s) associated with addressing White privilege, they were more likely to think about and express racial microaggressions. Implications of these findings and future research are discussed.

Keywords: Racial Microaggressions, White Privilege, Young Adults

Racial prejudice and discrimination are pervasive societal issues in the United States of America (USA) and can have serious negative implications (see Oswald, Mitchell, Blanton, Jaccard, & Tetlock, 2013). As such, it is important to explore potential factors that could influence the attitudes and behaviors that are associated with prejudice and discrimination. Research commonly defines prejudice as a negative evaluation of an individual or group of individuals on the basis of their group membership (Crandall, Eshleman, & O'Brian, 2002). These negative evaluations are often based on inaccurate information rooted in stereotypes (i.e., generalized beliefs about others, namely due to group membership / affiliation). As these negative evaluations of another develop, a certain attitude or affect also emerges that might form the basis of prejudice; thus, it is common to see prejudice cited in prior research as more of an attitude or evaluation of others that can be biased (Saucier, Miller, & Doucet, 2005). For instance, possessing an attitude(s) that individuals who live in a particular part of town are criminals or unsafe due to some cases of crime in the area, could lead to the formation of a stereotype (that serves to solidify a prejudiced attitude) that all individuals who live in that part of town are dangerous criminals.

In comparison, racial discrimination refers more to the behavioral component of racism. This includes a majority racial group member's actions that have negative effects on minority racial-ethnic individuals (Williams, Neighbors, & Jackson, 2003). Discrimination can manifest in a variety of ways; a major category focuses on the formation of negative attitudes (i.e., prejudice) and subsequent behaviors (i.e., discrimination) that majority group individuals display towards minority group members. Importantly, previous research suggests that holding a prejudicial attitude may potentially lead to acts of discrimination (Crandall et al., 2002).

Given that prejudicial attitudes can subsequently lead to discriminatory behaviors, current research has focused on the nature of prejudice and discrimination changing as a function of our society (Sue, Capodilupo, & Holder, 2008). Blatant racist attitudes that were seen as being acceptable decades ago (i.e., viewing minority members as second-class citizens) and the accompanying behaviors (i.e., segregated schools) have now become less acceptable to society as a whole. In other words, blatant and overt expressions of prejudice and discrimination have become less acceptable in society due to their outward displays of aggression and unfairness towards minority groups. Relevant to this societal shift, Sherif and Sherif's (1953) Group Norm Theory suggests that attitudes, values, beliefs and prejudices are all acquired as part of the socialization process. Thus, the development of prejudice-related norms (e.g., segregation) occur within social groups. These prejudice-related norms pressure individuals to conform to overall group norms. When prejudices are viewed as norms within society, individuals are more likely to develop and share the same prejudices (Crandall et al., 2002). Importantly, overt forms of racism were viewed as the overall group or societal norm in the USA until the rise of Affirmative Action. This new push of inclusivity changed the overall societal norms and made

overt acts of prejudice and discrimination unfavorable. However, the decrease in social acceptability of blatant racist acts does not mean that prejudice and discrimination are not present currently in society. Rather, expressions have evolved, the same way that societal expectations and norms have evolved over time. As such, the term modern racism has been used to describe the evolved expressions of prejudice and discrimination (McConahay, 1986; Poteat & Spanierman, 2012).

Modern Racism and Racial Microaggressions

Modern racism involves subtle expressions of discrimination when compared to the "old-fashioned" racism of the past (McConahay, 1986). In general, this subtle form of discrimination is still intended to belittle, offend, and/or discriminate against minority groups. For example, expressing to minority individuals that they insert themselves in places that they should not be (i.e., leaders of organizations; positions of power) with the intent to insult the abilities of the individual can be considered a form of modern racism (Young, Anderson, & Stewart, 2015). Although in general modern racism is still considered to be intentional, more recent research has begun to examine non-intentional forms of modern racism. More specifically, recent research has begun to explore any attitude, statement, or act that might not be intended to offend and/or be derogatory (and in some cases may be viewed as a compliment or praise by the perpetrator) but still communicates aspects of prejudice and discrimination (Pfeifer & Bernstein, 2003; Tarman & Sears, 2005).

Racial microaggressions are a form of modern racism that include subtle, stunning and often automatic "put-downs." Racial microaggressions tend to be verbal, behavioral, or environmental indignities (intentional or unintentional) that communicate hostile, derogatory, or negative racial slights or insults towards people of color (Sue et al., 2007). A White individual who says to a minority group member "you're a credit to your race" may not intend to communicate a derogatory message and may be perceived by the perpetrator as a genuine compliment, however, the underlying meaning of this statement conveys a message that the minority member is not as intelligent as a majority member. Further, making assumptions that an individual will be less intelligent or thinking that someone would physically harm you because of race are examples of potential manifestations of racial microaggressions (Sue et al., 2007; Wong, Derthick, David, Saw, & Okazaki, 2014). It is important to note that racial microaggressions may be expressed through actions/behaviors, such as overlooking or ignoring someone's opinion based on race and/or avoiding sitting next to someone in a public space because of the person's race. Racial microaggressions also may manifest as thoughts or attitudes, such as thinking that someone would not be intelligent because of this person's race and/or thinking someone would not be well-educated based on race. Prior research indicates that a person's prejudicial attitudes and/or thoughts may predict future discriminatory behaviors (Crandall et al., 2002). Thus, it is important to consider racial microaggressions through both thoughts and actions.

Important for the current study, previous literature has focused on how the experience of racial microaggressions can have detrimental effects, such as decreased self-esteem as well as increased stress, depression, and anxiety among minority groups (Wong-Padoongpatt, Zane, Okazaki, & Saw, 2017). While it is important to research and understand how minority individuals experience racial microaggressions and how racial microaggressions impact the overall functioning of minority individuals, there are very few studies that focus on how majority groups (i.e., White individuals) might understand their biases, how often they experience thoughts and actions associated with racial microaggressions, and how much they may agree with the underlying message being communicated by the racial microaggression. From the perspective of the majority group, additional variables may be examined as factors related to the thoughts/actions associated with racial microaggressions and agreement of racial microaggressions. One such variable might be White privilege.

A Connection to White Privilege

Previous research has defined White privilege as unearned advantages of being White in a racially stratified society (such as the USA) and is characterized as an expression of institutional power that is largely unacknowledged by most White individuals (Pinterits, Poteat, & Spanierman, 2009). McIntosh (1988) suggests that White individuals are carefully taught not to recognize White privilege, and therefore individuals may be unaware of the oppression that stems from White privilege. This unawareness may be due, at least in part, to the hierarchical design of the USA explained by Group Norm Theory and social dominance orientation; or the idea that societies are stratified on the basis of group distinctions (Fischer, Hanke, & Sibley, 2012; Pratto, Sidanius, Stallworth, & Malle, 1994). Potential advantages of White privilege could include having a lower chance to be the victim of police brutality or random drug stops, better access to healthcare, and a greater chance of being hired for a position based solely on being White (Conway, Lipsey, Pogge, & Ratliff, 2017). Many of these advantages are easily taken for granted and/or are not always recognized by White individuals because they may have never been in a situation that has challenged their place in society. For example, the Alliance for Board Diversity (2019) published a multiyear study of the Fortune 500 Boards and discovered that White men hold 66% of all Fortune 500 board seats and approximately 91% of the chair positions on those boards. The representation in

these Fortune 500 companies is far from the actual demographics of the population in the USA. For many majority group individuals, it is expected that they hold a high-power position and they may not be questioned on whether or not some form of privilege played a role in career advancement (Liu, 2017; Young et al., 2015).

Similar to how prejudice and discrimination are learned and shared by group norms and the socialization process, White privilege has been transferred in the same fashion and might be explained by the same Group Norm Theory (Sherif & Sherif, 1953). Based on this theory, values and beliefs surrounding White privilege are dictated by an individual's social group. Liu (2017) suggests that most individuals do not acknowledge they have the privileges in which they do because the privileges (e.g., social class and/or favorable treatment by law enforcement) have been passed down through the generations without being challenged by society as a whole. In the past several decades, the concept of White privilege has received an increase in conceptual and empirical attention, however, important to the current study, attitudes associated with White privilege remain understudied (Conway et al., 2017).

Due to a history of majority individuals being potentially unaware of the full extent of White privilege, there is a wide range of potential attitudes/reactions that White individuals might express in response to this privilege. Pinterits et al. (2009) suggested that there are three distinct dimensions associated with the attitudes surrounding White privilege: the affective dimension, the cognitive dimension, and the behavioral dimension. The affective dimension encompasses emotional responses associated with White privilege. Previous literature notes that common affective responses can include fear, guilt, and anger (Spanierman et al., 2008). Cognitive dimensions of White privilege attitudes focus on the continuum of one's awareness of White privilege, ranging from the denial of White privilege to critical consciousness (Pinterits et al., 2009). The behavioral reactions to White privilege focus on individuals' intentions and actions associated with this privilege. These intentions range from apathy to actions that work towards dismantling White privilege. Based on this multidimensional conceptualization of White privilege attitudes, Pinterits and colleagues (2009) developed the *White Privilege Attitudes Scale* that integrates the affective, cognitive and behavioral dimensions to assess White individuals' attitudes towards White privilege.

The *White Privilege Attitudes Scale* consists of four interrelated but conceptually distinct subscales; including the willingness to confront White privilege, anticipated costs of addressing White privilege, White privilege awareness, and White privilege remorse. The willingness to confront White privilege reflects a behavioral dimension in its assessment of intentions to address White privilege (Pinterits et al., 2009). Items relate to participants' plan(s) to address White privilege present in society and their willingness to explore their own White privilege. The anticipated costs of addressing White privilege reflect a mixture of the affective dimensions that are linked with potential behaviors associated with the fear of addressing or losing one's White privilege. This factor includes items that reflect a degree of trepidation about addressing White privilege or about the potential of losing one's own privilege. White privilege awareness is composed of items that represent the cognitive dimension of White privilege attitudes. These items reflect the degrees of consciousness and understanding of White privilege and racial inequities in the United States' society. White privilege remorse reflects the affective dimension of White privilege and measures the emotional responses about having race-based privileges. White individuals tend to be the least likely to experience a racial microaggressions and the most likely to be the perpetrators of one, so understanding how the privileges of these individuals' influence racial microaggressions is important (Miller & Saucier, 2018). Having an awareness of one's White privilege may also lead to an increased overall awareness of racial microaggressions.

The Current Study

The current research focused on how White individuals think about and use racial microaggressions and the level of agreement with the message being communicated by racial microaggressions. White privilege also was examined; four major factors of White privilege were considered: the willingness to confront White privilege, the anticipated costs of addressing White privilege, White privilege awareness, and White privilege remorse. Based on prior literature, two hypotheses were developed.

H1: The awareness, remorse, and willingness to confront White privilege will predict more agreement with the underlying meaning of racial microaggressions, whereas the costs that are associated with White privilege will predict less agreement with the underlying messages being communicated by racial microaggressions.

H2: The awareness, remorse, and willingness to confront White privilege will predict less actions and thoughts associated with racial microaggressions, whereas the costs that are associated with White privilege will predict more thoughts/actions of racial microaggressions.

Method

Participants

Based on the lack of prior literature focusing on majority groups' thoughts, actions, and underlying agreement with racial microaggressions, individuals who self-identified as White were the main focus of this study. It is important to note that all ethnicities had the opportunity to participate in the study for

research/course credits, however, only White individuals were included in the demographic information and analyses that follow. Undergraduate students (N = 70) from a small mid-western university were recruited from general education courses to participate in the study. The sample primarily consisted of first year of college students who self-identified as female (N = 56). Participants were between the ages 18 and 65.

Materials

White Privilege Attitudes Scale. Participants completed the *White Privilege Attitudes Scale* (Pinterits, et al., 2009), a 28-item measure rated on a 5-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree). These items assessed White privilege awareness (α = .84), White privilege remorse (α = .75), costs of addressing White privilege (α = .76), and the willingness to confront White privilege (α = .92). An example item from this scale is "I am worried that taking action against my White privilege will hurt relationships with other Whites."

Racial Microaggressions. The frequency of racial microaggression usage was measured using a self-constructed scale (α = .80) of 25 items rated on a 4-point Likert type scale (1 = Never; 4 = Often). An example item from this scale is "In the past six months have you avoided sitting next to someone in a public space (e.g., restaurant, movie, theater, subway, bus) because of their race?" (see appendix A). The level of agreement with the underlying messages that racial microaggressions express also was measured using a self-constructed scale (α = .76) consisting of nine items on a 5-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree). An example of this "When a White person says, 'When I look at you, I don't see color" to a person of color, they are communicating a message that denies that person's racial/ ethnic experiences" (see appendix B). These questions were developed based on the research done by Sue and colleagues over minority group's experience with racial microaggressions (Sue et al., 2007).

Procedure

Participants came to the lab to participate in the study. Participants read an informed consent that provided information on confidentiality and the voluntary nature of the study. Participants responded to demographic questions and the *White Privilege Attitudes Scale*. Participants also completed questions about their thoughts and actions regarding racial microaggressions as well as the agreement of the underlying message being communicated. Once participants completed the survey, they received a debriefing and were thanked for their participation.

Standard data cleaning procedures were utilized. The data were screened for missing data; for missing raw scores the average score was inserted in place of the missing data. Participants who did not complete at least 10% of the survey were not used in the analyses. Examination of the histograms indicated that the distribution shapes for each of the variables were normally distributed; skewness and kurtosis were used as an additional measure of distribution. For each variable of interest, the skewness and kurtosis were acceptable.

Results

Prior to the hypotheses being tested, a series of bivariate correlations were completed to explore the relationships between the variables of interest. The agreement of the underlying message being communicated by racial microaggressions was significant and positively related to the willingness to confront White privilege [r = .36, p = .002], the awareness of White privilege [r = .54, p < .001], and White privilege remorse [r = .35, p = .003]. Thus, the more individuals reported that they agreed that racial microaggressions communicated a derogatory message, they also were more likely to be willing to confront their White privilege, be aware that White privilege exists, and have feelings of remorse for having the unearned advantages in society. The anticipated costs of addressing White privilege were not found to be significantly related to the agreement to the underlying message being communicated by racial microaggressions. The thoughts/actions of racial microaggressions were only found to be significant and positively related with the costs associated with addressing White privilege [r = .36, p = .002]. When individuals reported a higher frequency of racial microaggressions, they also reported believing that there are more costs associated with addressing White privilege. See Table 1 for correlations between all variables of interest.

Hypothesis One

A multiple regression analysis was conducted to evaluate if the willingness to confront White privilege, White privilege awareness, and White privilege remorse would predict higher levels of agreement regarding the underlying message communicated by racial microaggressions. Further, it was expected that the anticipated costs of addressing White privilege would predict lower levels of agreement regarding the underlying message communicated by racial microaggressions. Overall, the regression model was significant [F (4, 68) = 6.74, p < .001; Adjusted R^2 = .25]. However, only the awareness of White privilege significantly predicted an individual's agreement with the underlying message being communicated by racial microaggressions [t (69) = 3.23; p = .002; β = .57]. The more aware individuals were aware of their White privilege, the more they agreed that the racial microaggressions communicated negative/derogatory messages.

Hypothesis Two

A multiple regression analysis also was conducted to determine if the willingness to confront White privilege, White privilege awareness, and White privilege remorse would predict less thoughts/actions of racial microaggressions. The costs associated with White privilege also was tested as a predictor of more thoughts/actions of racial microaggressions. Results indicate a significant model [F (4, 65) = 3.38. p = .014; Adjusted R^2 = 12]. However, the costs associated with addressing White privilege [t (69) = 3.30; p = .002; β = .30] was the only significant predictor. When individuals reported more costs associated with addressing their White privilege, they also reported more using racial microaggressions.

Discussion

Previous research has primarily focused on how the experience of racial microaggressions can have detrimental effects on minority members, such as decreased self-esteem as well as increased stress, depression, and anxiety (Wong-Padoongpatt, et al., 2017). While this research is needed to better understand the impact of racial microaggressions, it also is important to understand how majority members agree with and utilize racial microaggressions. The current study attempted to fill a gap in previous research by focusing on how majority group members not only agree with the messages communicated by racial microaggressions, but also how often majority group members use racial microaggressions. It is important to consider that majority group members may be the least likely to experience a racial microaggression in their daily lives, and as such, the most likely to be perpetrators of these expressions (Miller & Saucier, 2018). Group Norm Theory (Sherif and Sherif, 1953) suggests that individuals tend to develop similar prejudice-related norms based on societal expectations. Examining how often majority group members use racial microaggressions and if they agree with the harmful message(s) communicated may help researchers and practitioners better understand modern prejudice and discrimination. With more research on this topic, this may lead to better programming/education to help increase knowledge about racial microaggressions and decrease the frequency of these expressions.

Results indicated partial support for hypothesis one. White privilege awareness was the only significant predictor of the harmful message(s) being communicated by racial microaggressions. Awareness of White privilege (or awareness of the unearned advantages of being White) predicted more agreement that racial microaggressions communicate harmful, derogatory messages. This is consistent with prior research that indicates that awareness is often the first step when striving to make affective and/or behavioral changes. A 2014 meta-analysis examining prejudice prevention programs notes that the most effective programs focus on knowledge or awareness of prejudices that exist in society (Beelmann & Heinemann, 2014). Without the awareness that prejudice and discrimination are pervasive problems within society, individuals may not see a reason to change their behavior. Similarly, researchers in 2007 concluded that diversity management programs in corporations are having greater success with programs tailored to inform (or bring awareness) to prejudice and other diversity issues, however, the effect was short-term (Pendry, Driscoll, & Field, 2007). Along with more programs being designed to raise awareness of prejudice, there is also support that the awareness of White privilege can also lead to the reduction of prejudice related acts. A Texas university surveyed students at the beginning and end of a diversity course that discussed White privilege, prejudice and other diversity issues. Results of the study showed an increased awareness of White privilege and a reduction of prejudice (Case, 2007).

Results also indicated partial support for hypothesis two. The anticipated costs of addressing White privilege was the only significant predictor of using racial microaggressions. When individuals perceive and/or fear that there are high costs associated with addressing White privilege (e.g., losing support from one's friend or family if they confront White privilege; losing a career position) this was predictive of increased use of racial microaggressions. Losing these privileges may cause individuals to engage in behaviors that maintain these advantages; perhaps the perception and/or fear of losing these advantages might explain why participants who reported more costs also use racial microaggressions more frequently. This idea is consistent with the construct of social dominance orientation (Pratto et al., 1994). Social dominance orientation posits that individuals naturally organize themselves into hierarchies within society on the basis of gender, age and arbitrary group distinction (Fischer et al., 2012). In the USA, White individuals have remained at the top of this hierarchy since the birth of the nation in 1776. Thus, when their place in society is challenged, they may be more likely to engage in behaviors that might be discriminatory, such as using a microaggression(s), that enforce the current hierarchies that are in place (Fischer et al., 2012). However, more research is needed on this topic in order to better understand White privilege awareness and the costs associated with addressing White privilege in relation to racial microaggressions.

Limitations and Future Directions

The sample used for the current study represents the views of a small Midwestern university but may not be representative of the population at large. Students from this university typically come from rural areas with low populations and little diversity. The generalizability of the study to all majority group members may be limited. Future research would benefit from a larger sample with individuals from various regions throughout the USA and

should consider examining additional variables like socioeconomic status and political affiliation. Further, when this study was designed, to the researcher's knowledge there were not validated scales used to measure the agreement and the usage of racial microaggressions among majority group members. The scales used in this study were adapted from Sue and colleagues (2007) seminal work, which gave examples of racial microaggressions and what the underlying message of the racial microaggression communicated to a minority individual. Future research might benefit from using validated measures. After the completion of this study, a scale was published on the acceptability of racial microaggressions; future research might benefit from this validated measure (Mekawi & Todd, 2018). In addition, SurveyMonkey was used to administer the materials to the participants and was coded to randomize the survey questions. However, we were unable to track which order the pages were presented to the participants; and therefore, we were unable to confirm or test for any order effects. Finally, only the variable of White privilege was examined in relation to racial microaggressions. Additional variables (e.g., mediators and/or moderators) that might further explain the usage of racial microaggressions, and agreement of the underlying messages would be beneficial.

Overall, the current study attempted to fill a gap in previous research by focusing on how majority group members not only agree with the messages communicated by racial microaggressions, but also how often majority group members use racial microaggressions. Examining how often majority group members use racial microaggressions and if they understand the harmful message(s) that is communicated may help researchers and practitioners better understand modern prejudice and discrimination. With more research on this topic, this understanding may lead to better programming/education to help increase knowledge about racial microaggressions and decrease the frequency of these expressions.

References

Alliance for board diversity report. (2019, January). Retrieved from https://www.leap.org/alliance-for-board-diversity-report

Beelmann, A., & Heinemann, K. S. (2014). Preventing prejudice and improving intergroup attitudes: A meta-analysis of child and adolescent training programs. *Journal of Applied Developmental Psychology, 35*, 10-24. doi: 10.1016/j.appdev.2013.11.002

Case, K. A. (2007). Raising White privilege awareness and reducing racial prejudice: Assessing diversity course effectiveness. *Teaching of Psychology 34*(4), 231-235.

Crandall, C. S., Eshleman, A., & O'Brien L. (2002). Social norms and the expression and suppression of prejudice: The struggle for internalization. *Journal of Personality and Social Psychology, 82*(3), 359-378. doi: 10.1037//0022-3514.82.3.359

Conway, J. G., Lipsey, N. P., Pogge, G., & Ratliff, K. A. (2017). Racial prejudice predicts less desire to learn about White privilege. *Social Psychology, 48*(5), 310-319. doi: 10.1027/1864-9335/a000314

Fischer, R., Hanke, K., & Sibley, C. G. (2012). Cultural and institutional determinants of social dominance orientation: A cross-cultural meta-analysis of 27 societies. *Political Psychology, 3*(4), 437-467. doi:10.1111/j.1467-9221.2012.00884.x

Liu, W. M. (2017). White male power and privilege: The relationship between White supremacy and social class. *Journal of Counseling Psychology, 64*(4), 349-358. doi: 10.1037//cou0000227

McConahay, J. B. (1986). Modern racism, ambivalence, and the modern racism scale. In J.F. Dovidio, & S.L. Gaertner (Eds.). *Prejudice, discrimination, and racism,* (pp. 91-125). New York, NY: Academic Press.

McIntosh, P. (1988). White privilege: Unpacking the invisible knapsack. In S. Plous (Ed.), *Understanding prejudice and discrimination* (pp. 191–196). New York, NY: McGraw-Hill.

Mekawi, Y., & Todd, N. R. (2018). Okay to Say?: Initial validation of the acceptability of racial microaggressions scale. *Cultural Diversity and Ethnic Minority Psychology*. doi: 10.1037/cdp0000201

Miller, S. S., & Saucier, D. A. (2018). Individual differences in the propensity to make attributions to prejudice. *Group Processes and Intergroup Relations, 21*(2), 280-301. doi: 10.1177/1368430216674342

Oswald, F. L., Mitchell, G., Blanton, H., Jaccard. J., & Tetlock, P. E. (2013). Predicting ethnic and racial discrimination: A meta-analysis of IAT criterion studies. *Journal of Personality and Social Psychology, 105*(2), 171-192. doi: 10.1037/a0032734

Pendry, L. F., Driscoll, D. M., & Field, S. C. T. (2007). Diversity training: Putting theory into practice. *Journal of Occupational and Organizational Psychology, 80*, 27-50. doi:10.1348/096317906X118397

Pfeifer, J. E., & Bernstein, D. J. (2003). Expressions of modern racism in judgments of others: The role of task and target specificity on attributions of guilt. *Social Behavior and Personality, 31*(8), 749-766. doi: 10.2224/sbp.2003.31.8.749

Pinterits, E. J., Poteat, V. P., & Spanierman, L. B. (2009). The White Privilege Attitudes Scale: Development and initial validation. *Journal of Counseling Psychology, 56*(3), 417-429. doi: 10.1037/a0016274

Poteat, V. P., & Spanierman, L. B. (2012). Modern racism attitudes among White students: The role of dominance and authoritarianism and the mediating effects of racial color-blindness. *Journal of Social Psychology, 152*(6), 758-774.

Pratto, F., Sidanius, J., Stallworth, L. M., & Malle, B. F. (1994). Social dominance orientation: A personality variable predicting social and political attitudes. *Journal of Personality and Social Psychology, 67*(4), 741-763.

Saucier, D. A., Miller, C. T., & Doucet, N. (2005). Differences in helping Whites and helping blacks: A meta-analysis. *Personality and Social Psychology Review, 9*(1), 2-16. doi: 10.1207/s15327957psrp0901_1

Sherif, M., & Sherif, C. W. (1953). *Groups in harmony and tension,* New York: Harper.

Spanierman, L. B., Oh, E., Poteat, V. P., Hund, A. R., McClair, V. L., Beer, A. M., & Clarke, A. M. (2008). White university students' responses to societal racism: A qualitative investigation. *The Counseling Psychologist, 36,* 839-870. doi: 10.1177/0011000006295589

Sue, D. W., Capodilupo, C. M., & Holder, A. M. B. (2008). Racial microaggressions in the life experience of Black Americans. *Professional Psychology: Research and Review, 39*(3), 329-336. doi: 10.1037/0735-7028.39.3.329

Sue, D. W., Capodilupo, C. M., Torino, G. C., Bucceri, J. M., Holder, A. M. B., Nadal, K. L., & Esquilin, M. (2007). Racial microaggressions in everyday life: Implications for clinical practice. *American Psychologist, 62*(4), 271-286. doi: 10.1037/0003-066X.62.4.271

Tarman, C., & Sears, D. O. (2005). The conceptualization and measurement of symbolic racism. *The Journal of Politics, 67*(3), 731-761. doi: 209.114.105.254

Williams, D. R., Neighbors, H. W., & Jackson, J. S. (2003). Racial/ethnic discrimination and health: Findings from community studies. *American Journal of Public Health, 93*(2), 200-208. doi: 10.2105/AJPH.93.2.200

Wong-Padoongpatt, G., Zane, N., Okazaki, S., & Saw, A. (2017). Decreases in implicit self-esteem explain the racial impact microaggressions among Asian Americans. *Journal of Counseling Psychology, 64*(5), 574-583. doi: 10.1037/cou0000217

Wong, G., Derthick, A. O., David, E. J. R., Saw, A., & Okazaki, S. (2014). The what, the why, and the how: A review of racial microaggressions research in psychology. *Race and Social Problems, 6*(2), 181-200. doi: 10.1007/s12552-013-9107-9

Young, K., Anderson, M., & Stewart, S. (2015). Hierarchical microaggressions in higher education. *Journal of Diversity and Higher Education, 8*(1), 61-71. doi: 10.1037/a0038464

Journal of Psychological Inquiry
2020, Vol.24, No. 2, pp. 37-41

INCORPORATING ACCOUNTABILITY AND COORDINATION IN FITNESS PLANS TO INCREASE GOAL PROGRESS

DANYELLE WELLS, KAITLYN RUPP, AMANDA MARTIN, AND DARSHON ANDERSON
UNIVERSITY OF CENTRAL ARKANSAS

Abstract – The purpose of this study was to examine the effect the type of fitness plan had on frequency of workouts and fitness goal progress in a college population. It was hypothesized that students who utilized a workout plan that included accountability and/or coordination would have increased frequency of workouts and more goal progress than those who worked out with a plan that lacked these concepts. Participants completed a survey that focused on the type of fitness plan used, frequency of workouts, and progress towards a fitness goal. Results showed that students who used a trainer or a mobile application worked out more on average than students who reported just going to the gym and were more likely to be in an action phase of goal pursuit. These results support incorporating accountability and implicit coordination into plans to increase effort and motivation. Specifically, fitness goals that are made public or that require some form of accountability (i.e. using a trainer, mobile app, etc.) can increase physical activity in the college population.

Keywords: goal pursuit, goal progress, fitness, workout plans

Goals related to health and wellness are common in society. At the beginning of each new year, millions of people establish new year's resolutions that include losing a set number of pounds, going on a diet, beginning a workout plan, joining a gym or health facility, etc. However, the individual pursuit of these resolutions will vary. They vary by things such as weight loss, weight gain, strength enhancement, or maintenance of overall fitness and wellness. With these different focuses and objectives, differing levels of motivation and effort can be expected. Research has found variables such as age and gender can affect the orientation of an individual's fitness goal (Ebner, Freund, & Baltes, 2006). For example, both males and females in older generations may focus solely on overall well-being, while younger generations focus on specific outcomes. More specifically, the desire of males is to gain muscle while females concentrate on weight loss (Stults-Kolehmainen et. al., 2013). However, the majority of fitness goals are oriented toward weight loss. Despite the type of goals, there are many obstacles that can prevent individuals from achieving their health goal. One major obstacle is not having a fitness or health plan. Various studies have shown that having a plan or "implementation intention" leads to effortful goal pursuit. But does the type of fitness plan used lead to more goal progress? Specifically, would working with a trainer who can provide accountability or using a cell phone health application that provides opportunity coordinated workouts produce more progress in health goals than just going to the gym without accountability or coordination? Research has yet to examine the difference in goal progress when specific health plans are used. Thus, the purpose of the present study was to provide insight into how fitness plans impact fitness activities and goal pursuits.

According to Barnett et al. (2014), 49% of surveyed college students do not meet minimal exercise guidelines although many report going to the gym and engaging in physical activity. This finding is suggestive that college students set health goals, but fail to meet these goals. And when compared to other age groups, college students are not meeting health guidelines. Although there is a strong perception that physical activity decreases with age, research suggests a curvilinear relationship. Kozma, Stones, and Hannah (1991), found that younger and older individuals tend to be more active than the middle age group. However, it is not known whether having a workout plan specifically leads younger people to actively pursue a fitness goal based on the research examining age differences. We cannot assume that if a goal is actively being pursued that the goal will be met due to many reasons for goal failure. However, one factor that could have a large impact on the goal outcome in the college population could very well be what type of fitness plan is utilized during the pursuit.

Approaching a fitness goal without a plan would be the surest way to fail. Numerous studies have shown that plans are essential to overcome obstacles that would impede progress toward the goal. For example, when individuals are aware of obstacles that may interfere with their goal pursuit, they are more apt to maintain goal-directed intentions (Gollwitzer, 1999). Furthermore,

individuals that use a predetermined plan are more likely to actively pursue their goals. Research also suggests that to be properly equipped for goal pursuit individuals should spend time evaluating the advantages and disadvantages in the goal setting phase, determine the necessary actions to take in the planning phase, and to maintain mental representations of the goal outcome while executing the course of action in the process phase (Gollwitzer, 1990, Pham & Taylor, 1999). Some common obstacles to pursuing health related goals in the college population include lack of time, working, sleep, or family obligations. So, having a plan in place to overcome such obstacles would minimize the effect of the obstacle on the health goal.

Another strategy to increase the likelihood of success during goal pursuit is to make the goal public (i.e. telling someone or documenting the goal in written form). This strategy is said to increase success because it provides a level of accountability by way of others asking about the progress of the goal or the pursuer being faced with the written proclamation of the goal. There is even evidence that sharing intentionality with similar others leads to implicit coordination, which manifest itself in goal-congruent behaviors (Shteynberg, & Galinsky, 2011). College students have the option of making their health goals public by sharing them with friends, family, or documenting them in a personal journal. Similarly, students could publicize their health goal by employing a personal trainer. Personal trainers provide a significant level of accountability by providing their client's pre and post body analyses, putting their clients on a weekly workout schedule that they coach them through, and monitoring their client's progress through weigh ins and measurements. Additionally, students using mobile fitness applications can be held accountable for their health goals by receiving text notifications or alerts to remind them to complete their workout and provide weekly updates on their workout frequency. Using personal trainers or mobile fitness applications can also provide students the opportunity to coordinate their goals with their peers by joining personal training groups or signing up for mobile app challenges.

There are various strategies that individuals can use to achieve their fitness goals that include personal trainers, mobile applications (i.e. MyFitnessPal, MapMyRun, etc.), fitness classes/instructors, online workouts (i.e. Pinterest & blogs), and online challenges. While trainers and fitness classes are still widely used, they are not as modern as phone applications and online workouts. And because phone applications and online workouts are contemporary, there is limited research covering them. Many tools claim to be the most successful with helping to lose 10 pounds or getting fit for spring break, but it can be difficult to filter through so many options and determine the most effective strategy.

The purpose of this study was to examine differences in goal progress across fitness plans used in a college population. Based on review of past research and literature, two outcomes were hypothesized. First, students with a fitness plan that included accountability and/or coordination (such as personal trainers, group exercise classes, and mobile applications would show a significant increase in frequency of workouts in pursuit of their fitness goal. Second, students that utilized a fitness plan that included accountability and/or coordination would be more apt to be in the action or maintenance stage of pursuing their fitness goal (Bayuk, 2015) compared to the pre-contemplation or contemplation phases. The reasoning behind these predictions are connected to work focused on accountability and coordination (Sheeynberg & Galinsky, 2011; Converse, Piccone, Lockamy, Miloslavic, Mysiak, & Pathak, 2014). Having accountability built into the fitness plan should aid in progress towards the goal outcome due to increases in effort. Implicit coordination leads to individuals working on the same goal when in close relationships such as friendships or dating relationships. It is expected that college students spend a significant amount of time with friends with similar goals, which will increase the amount of time they spend participating in physical activity. Without following a plan that includes accountability and/or coordination, we predict that the individuals will spend less time participating in physical activity and will remain in the contemplation phase of goal pursuit.

Method

Participants

G*Power is a tool to compute statistical power analyses for many different t tests, F tests, $\chi 2$ tests, Z tests and some exact tests. This software revealed a sample size of 42 participants were needed to achieve eighty percent power and to detect a large (.80) effect size. The total number of participants included 43 undergraduate students (14 males, 29 females) enrolled in Psychology courses at a four-year university. Of those participants, 6 were freshmen, 9 were sophomores, 9 were juniors, and 19 were seniors. Participants' ranged in age from 18 to 22, with a mean age of 20. All participants were required to have a fitness goal to participant in the study. Participants received course credit for their participation in study.

Materials

Participants completed a demographic survey and the Trans Theoretical Model (TTM) questionnaire developed by Prochaska and DiClemente (1983). The demographic survey included ten questions. The first question asked, "Do you have a fitness goal?" Demographic questions were asked that included gender, age, race, ethnicity, and class. Other questions asked included, "Do you have a fitness plan?", "What type of fitness plan do you use?", "How many days a week on average do you work out?", and "How much have you progressed towards your fitness goal?" The response to

the second question about the type of fitness plan used was the quasi-independent variable that categorized into two groups of responses. The first group included responses with personal trainers, fitness classes, or fitness mobile applications. The second group included responses of not have a fitness plan or "other".

The TTM was used to assess goal progress, which was the primary dependent variable. The TTM was originally developed to measure the process of smoking cessation and it focuses on intentional change using the assumption that behaviors are not changed quickly or decisively. The TTM includes five stages of change, which occur continuously through a cyclical process (Prochaska & DiClemente, 1983). The first stage is Pre-contemplation; people who selected this category do not intend to change a behavior or are possibly unaware that they need to change. The second stage is Contemplation; people who selected this category do intend to change a behavior within six months. The third stage is Preparation; people who selected this category are intending to make a behavioral change in the next thirty days. The fourth stage is Action; people who selected this category have changed their behavior in the last six months and are continually working toward their goal. The fifth stage is Maintenance; people who selected this category have changed their behavior more than six months ago and are aware of the actions that are required to maintain their lifestyle.

The current study utilized this model based on its stage theory, which is similar to implementation intentions and goal planning work by Gollwitzer (1999). By editing the original smoking cessation questions, the TTM was used to determine participant's progress on their fitness goal. The responses given on the progress questions were categorized as follows: 1= Precontemplation, 2 = Contemplation, 3 = Preparation, 4 = Action, and 5 = Maintenance. Both the demographic survey and the TTM questionnaire were taken by participants using qualtrics.com, which is software platform that allows researchers to capture and analyze survey data from users inside or outside of their organization. Participants completed both surveys using campus computer access.

Procedure

The participants first provided informed consent and then completed the survey. Students participating in the study were required to have a fitness goal. The students who selected "no" to having a goal were finished with the survey, while those who selected "yes" continued with the survey. Next, demographic questions were completed. If the participant answered no to having a fitness plan, then they were automatically directed to the progress questions, while participants who answered yes were directed to select the option that best described their fitness plan. After selecting a detailed option or the "other" category, participants were directed to answer questions that asked their frequency of workouts and goal progress.

Design and Analysis

This study used a quasi-experimental design where we examined how a fitness plan impacts fitness goal pursuit. Goal progress and frequency served as dependent variables while fitness plan served as the quasi-independent variable. The two levels of the independent variable were fitness plans that included accountability or coordination and plans without accountability or coordination. Independent sample t-tests were used to analyze the frequency of workouts and progression towards the goal pursuit across the two levels.

Results

Our first research question examined the effect of utilizing a fitness plan that included accountability and/or coordination on frequency of workouts. There was a significant difference between the students who utilized plans that included accountability or coordination, and those that did not, $t(41) = 5.64$, $p < 01$, $d = 1.86$. The data revealed that students who utilize a trainer, fitness classes, and mobile applications worked out an average of 4.2 days a week (SD =1.70), while students who reported just going to the gym, running or walking worked out an average of 1.71 days a week (SD = .82). This suggest those using a plan that incorporated accountability or coordination worked out twice as much as those who did not. Our second research question examined the effect of the type of plan on progress towards a fitness goal. There was a significant difference in TTM ratings depending on if the plan used included accountability or coordination, $t(41) = 5.77$, $p < .05$, $d = 1.82$. Participants utilizing a trainer or mobile application reported being in the Action Phase, whereas those who just went to the gym reported being in the Contemplation Phase. This suggests having accountability and/or coordination infused in the plan increased the progression toward the goal.

Discussion

The purpose of this study was to investigate the effects of fitness plans on individual's pursuit to their fitness goals. We hypothesized that individuals who utilized a fitness plan that included accountability and/or coordination would have a higher frequency of workouts, which our results supported. There was a significant difference between the students who utilized plans that included trainers and mobile applications compared to those who did not. The second hypothesis stated, individuals who utilized a fitness plan with accountability and/or coordination would be more likely to be in the action or maintenance stage of the TTM. This hypothesis was also supported. There was a difference in reported stages of progression across the fitness plan categorization. Taken together, these results suggest having a fitness plan that includes accountability and/or

implicit coordination not only increases physical activity but also moves a person closer to their health outcomes.

The results of the current study also provide evidence for the use of fitness plans that include accountability and/or coordination to increase motivation via awards and rewards. Domangue and Solmon (2010) found that award-based systems increased student's activity motivation. While our study did not inquire about reward systems, this could have been a key component for some student's motivation, particularly those using trainers or mobile applications. For example, if a student has a goal to lose ten pounds, they might reward themselves by purchasing something they have had their eye on. Other reward systems could include monetary values, tangible items, or even words of encouragement. Particularly, students who used trainers or mobile applications could receive rewards from their trainer, gym, or health store that might include free gym memberships, discounts on apparel or health drinks, or other prizes. Future studies could examine how rewards and incentives built into fitness plans (apps, gym membership perks, etc.) impact the use of those plans across age and gender. Interestingly, Ebner et al. (2006) found that younger adults tend to have goals in the planning or action phase, while older adults tend to have goals in the maintenance phase. This aligns with our results as there were more participants that reported being in the action stage of TTM rather than the maintenance stage, and our population was centered on college aged students.

This study did have certain limitations that hinder generalizability. First, the sample of this study was limited to college student population for convenience. If the sampling were extended to a larger community, other demographic variables such as age and gender could have been included in analyses to determine if goal strategies differ among age and gender groups. Future research should include a larger sample from the community to examine these questions.

Another limitation of this study was the response categories to the type of fitness plan question. Participants could answer the type of fitness plan question by selecting trainer, fitness class, app, or other, which the first two categories were the most frequently given responses in a pilot study of 20 college students. However, the "other" category was selected by several participants. We did not include a free response for the "other" category to determine what types of plans participants were using. Ultimately, adding a free response option for the "other" category could have revealed what other type of plans increased frequency and progress toward the fitness goal. Future research should take this into consideration. Future research should continue to focus on the effect of workout plans on progress towards fitness goals to improve the obesity and diabetes epidemic that affects millions of Americans. Future research could also focus on gender and age differences to determine the best plan to help them achieve their fitness goals. Knowing these differences could help professionals promote fitness plans to fit specific gender and age categories that lead to increased progress towards fitness goals.

In conclusion, individuals who use fitness plans that include accountability and/or coordination are more likely to workout frequently and make greater progress towards their goals. This progression was shown by frequency and duration of time spent towards goal. Other ways to measure progress towards fitness goals could include amount of weight loss or gained, muscle mass loss or gained, cholesterol levels, and other health measures. This would further indicate that having a plan with accountability or coordination significantly helps individuals progress towards their goal. While our hypotheses were supported, there are many fitness goal pursuit factors that are left to research including the type of fitness plan that leads to these increases.

References

Barnett, N. P., Ott, M. Q., Rogers, M. L., Loxley, M., Linkletter, C., & Clark, M. A. (2014). Peer associations for substance use and exercise in a college student social network. *Health Psychology*, *33*(10), 1134-1142. doi:10.1037/a0034687

Bayuk, J. (2015). Should I plan? Planning effects on perceived effort and motivation in goal pursuit. *Journal of Consumer Behaviour*, *14*(5), 344-352. doi:10.1002/cb.1525

Converse, P. D., Piccone, K., Lockamy, C. N., Miloslavic, S. A., Mysiak, K., & Pathak, J. (2014). The influence of perceived accountability and outcome interdependence on goals and effort. *Journal of Applied Social Psychology*, 44(3), 210-219. doi:10.1111/jasp.12216

Direito, A., Yannan, J., Whittaker, R., & Maddison, R. (2015). Smartphone apps to improve fitness and increase physical activity among young people: protocol of the Apps for IMproving FITness (AIMFIT) randomized controlled trial. *BMC Public Health*, *15*(1), 635-646. doi:10.1186/s12889-015-1968-y

Domangue, E., & Solmon, M. (2010). Motivational responses to fitness testing by award status and gender. *Research Quarterly for Exercise and Sport, 81*(3), 310-8.

Ebner, N. C.,Freund, A. M., & Baltes, P. B. (2006). Developmental changes in personal goal orientation from young to late adulthood: From striving for gains to maintenance and prevention of losses. *Psychology and Aging*, *21*(4), 664-678. doi:10.1037/0882- 7974.21.4.66.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and

biomedical sciences. *Behavior Research Methods*, 39, 175-191.
Fischer, D. V., & Bryant, J. (2008). Effect of Certified Personal Trainer Services on Stage of Exercise Behavior and Exercise Mediators in Female College Students. *Journal of American College Health, 56*(4), 369-376
Gollwitzer, P. M. (1990). Action phases and mindsets. In E. T. Higgins & R. M. Sorrentino (Eds.) Handbook *of motivation and cognition: Foundations of social behavior*, Vol. 2. The Guilford Press. Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist*, 54, 493-503.
Kozma, A., Stones, M. J., & Hannah, T. E. (1991). Age, activity, and physical performance: An evaluation of performance models. *Psychology and Aging*, *6*(1), 43-49. doi:10.1037/0882-7974.6.1.43.
Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*(3), 390-395.
Peñas-Lledó, E., Sancho, L., & Waller, G. (2002). Eating attitudes and the use of alcohol, tobacco, and exercise among male and female adolescents. *Eating Behaviors*, *3*(2), 101-111. doi:10.1016/S1471-0153(01)00047-2.
Richards, J. (2013). Face-to-face versus remote and web 2.0 interventions for promoting physical activity. *Cochrane Database of Systematic Reviews*, (9), Art. No.: CD010393. doi:10.1002/14651858.CD010393.pub2
Shteynberg, G., & Galinsky, A. D. (2011). Implicit coordination: Sharing goals with similar others intensifies goal pursuit. *Journal of Experimental Social Psychology*, 47(6), 1291-1294.
Stults-Kolehmainen, M., Ciccolo, J. T., Bartholomew, J. B., Seifert, J., & Portman, R. S. (2013). Age and gender-related changes in exercise motivation among highly active individuals. *Athletic Insight, 5*(1), 45-63.

CALL FOR PAPERS

The *Journal of Psychological Inquiry* encourages undergraduate students to submit manuscripts for publication. Consider the following when you begin to write your manuscript.

- Manuscripts must have an undergraduate student as the primary author. Manuscripts written by anyone who has already graduated from college will be accepted if the work was completed while the primary author was still an undergraduate student. Graduate students or faculty may be co-authors, if their role was one of teacher or mentor versus equal collaborator.
- Include a sponsoring statement from a faculty supervisor. Faculty sponsors should confirm that they inspected the paper's content, method, adherence to APA style and ethics, grammar, and overall presentation. This sponsoring statement should be uploaded with the manuscript.
- For a manuscript to be considered for publication in JPI, the first author must meet one of the following conditions: a) the primary author has paid a one-time $30 processing fee, or b) the primary author is or was a student at an institution that has paid an annual $80 processing fee for unlimited submissions from students who attend that institution.
- Submit original manuscripts only. Do not submit manuscripts that have been accepted for publication or have been published elsewhere.
- All manuscripts should be formatted in accordance with the latest edition of the APA Publication Manual.
- To submit a manuscript, go to the submission portal at www.editorialmanager.com/jpi
- The reviewing process should require at least 90 days between submitting a manuscript and receiving a reply from the action editor.
- If a manuscript requires revisions, the author or authors are responsible for making the necessary changes and resubmitting the manuscript to the journal. Manuscripts may need to be revised more than once before being accepted for publication.

The *Journal of Psychological Inquiry* publishes each of the following kinds of articles.

- 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.
    - Examples:
        - Developmental psychology: Does violence in the media have harmful effects on children?
        - Human sexuality: Is homosexuality incompatible with military service?
        - Cognitive psychology: Are repressed memories real?
    - 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 type of article is a psychological analysis of a television program or movie.
        - Select an episode from a popular, 30-60 minute television program, or a well-known feature-length film (typically between 90 and 120 minutes long).
            - Describe the salient behaviors, activities, and / or interactions of the main characters, and interpret them using psychological concepts and principles.
            - Use appropriate concepts and principles from the research literature.
            - The manuscript should identify the title of the show or film, and for television shows, the name of network and episode.
            - See the APA style guide to find out how to appropriately reference an episode of a television show or movie.

- Special features III: Conducting psychological analyses – Current events
    - This type of article analyzes a current event.
        - Select an event that has garnered widespread coverage in the national media.
        - Analyze the event from one or more areas of psychology.
        - Pay close attention to the people at the center of the event, and to the people who were affected, directly or indirectly, by the event.
            - What were their motivations, expectations, and reactions to the event?
- Special features IV: Teaching techniques
    - The student and faculty mentor should select a teaching technique used by the faculty member that the student found to be particularly helpful in promoting learning.
    - Describe the technique in sufficient detail so other faculty members can replicate the technique in their own teaching.
    - Provide reasons why the student thought the technique worked so well.
    - The faculty member should explain why they developed the technique, and what they hoped to accomplish in terms of learning outcomes.