THE EFFECTS OF EXERCISE ON PERSON MEMORIES AND STEREOTYPE ASSOCIATION

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Abstract

In this study, we examined how a single bout of intense exercise and repeated exposure to individuating information changes the accessibility to person versus group-based memories. Participants were presented with information about social targets, and the extent to which this information was associated with these targets was tested immediately after exposure and 48 hrs after exposure. Participants (N = 77) were randomly assigned to one of two groups: exercise or control. Exercise consisted of 20 min on a cycle ergometer. Participants responded significantly faster to individuating traits during a lexical decision task to new and exposure targets 48 hrs after exposure versus immediately after exposure. We found that exercise, time, and repeated exposure, had no significant impact on how participants responded to individuating and stereotypic traits paired with the learned targets 48 hrs after exposure. We found that participants processed both stereotypes and individuating traits equally, immediately following exposure.

The Effects of Exercise on Person Memories and Stereotype Association

As the country has grown increasingly diverse, first impressions of individuals often rely on each other's memberships in social categories such as race, religion, and gender instead of individual behavior. This information that shapes our impressions has been differentiated by social psychologists into two major categories: stereotypes and individuating information. While stereotypes associate traits and behavior to membership in social categories, individuating information refers to any information known about the individual (Kunda & Thagard, 1996). Early theorists maintain that impressions of individuals reflect an integration of all the information known to characterize that person (Anderson, 1968; Asch, 1946; Kunda & Thagard, 1996). However, recent models of impression formation assume that individuals first and automatically rely on stereotypes when forming an impression because stereotypic memories consist of stronger associations and are well learned, whereas individuating memories are, at first, recalled with effort (Fiske & Neuberg, 1990). Furthermore, it has been argued that stereotypes are the core to one's beliefs about the likely traits and behaviors of individuals about whom no additional individuating information is available. Thus, social categorization leads to automatic activation of stereotypes associated with that social category which then potentially guides prejudicial attitudes (Brewer, 1988; Fazio, Jackson, Dunton, & Williams, 1995; Fiske & Neuberg, 1990; Zárate & Smith, 1990).

However, other research has found that the reliance on stereotypes can be changed over time with experience (Wheeler & Fiske, 2005). Even though stereotypes affect impressions of individuals about whom nothing else is known, later impressions of familiar individuals may proceed differently due to the previous individuating experiences. Stereotypes typically have no effect when individuating information is obtained and this information goes beyond group

membership or contradicts stereotypes (Kunda & Thagard, 1996). More importantly, research has begun to show the malleability of stereotype activation through memory consolidation of individuating information (Brebner et. al, 2009; Kawakami et. al, 2000; Macrae et. al, 1997; Quinn et. al, 2009; Reder et. al, 2013) and that exposure to individuating information may lead to more trait-based impressions. For instance, research has found that previous exposure to an individual (without individuating information) can increase rates of stereotyping (Smith, Miller, Maitner, Crump, Garcia-Marques, & Mackie, 2006). Other research has found that forming and reporting impressions over time (e.g., a semester) may lead to more trait-based impressions (Park, 1986). Still, although a significant proportion of social interactions occur over time, we know little about the mechanisms of how impressions of others are influenced by memory consolidation. To address this question, the proposed research worked to extend and merge previous work on social perception and memory consolidation to demonstrate that memory consolidation may lead to a faster association with individuating information over stereotypes.

Social Perception

The tendency to classify experience into categories is a fundamental aspect of human cognition. Concepts are created in order to make sense of the endless complexity encountered in our environment. This is a necessary part of human thought, because it allows information to be processed efficiently and quickly. Research has described this process as a means of conserving cognitive capacity while navigating our social environment (Macrae et. al, 1994). And while much research has shown the automaticity of stereotyping, present research examines the ways in which learned individuating information may be integrated with stereotypic information. Research has recently begun to examine not only how social categorization affects how we perceive and judge others, but also how we remember individuals. While the prevailing

argument within the stereotyping literature asserts that people automatically categorize others in terms of a social category (e.g., race, gender), this argument is based on studies that have examined the effects of first impressions primarily within one experimental session using only novel faces (Devine et al, 1989). Thus, this experimental design has led to an incomplete understanding of stereotyping. It's important to note that a first impression is based on limited information that relies on the activation of stereotypes. This reliance on associated stereotypes then becomes the most accessible information one has about the person (Fiske & Neuberg, 1990). However, the question then becomes how these impressions change over time due to previous individuating experiences and memory retention.

Social Perception and Memory

Stereotypes are consolidated memory structures that can be applied easily and effortlessly. For instance, there is considerable evidence that stereotypes can be activated spontaneously on exposure to a stereotyped individual (Bargh, 1999). Research has also found that brief exposure to individuals from different racial groups prompts the automatic activation of the relevant stereotype (Gilbert & Hixon, 1991; Kunda et al., 2002; Macrae et al., 1995; Pendry & Macrae, 1996; Sinclair & Kunda, 1999). This automatic activation may be due to the fact that individuating information about a social target takes time and effort to be recalled, whereas stereotypes are well learned. Because of this distinction between stereotypic memories and individuating memories, it may be unreasonable to expect that newly learned individuating information will outweigh well-learned stereotypic information. However, it's important to note that while applicable stereotypes can be activated spontaneously as soon as one encounters a person, that activation may fade after further exposure to the person (Kunda et. al, 2002, 2003). As the memories persist through further exposure, attention shifts from a category membership

to the person's individuating information. This shift occurs when the association with individuating information becomes stronger and the information is integrated and stabilized into memories. This formation of stable memories with novel faces better facilitates the association of an individual with a distinguishing trait rather than activating stereotypes (Reder et al., 2013). When one has other information about a person, group stereotypes become irrelevant (Kahneman & Tversky, 1973). Thus, receiving individuating information during an interaction with a stereotyped individual may inhibit the activation of the stereotype (Kunda & Thagard, 1996; Zacks & Hasher, 1994). This shift in the reliance on stereotypes to individuating information occurs when individual memories are consolidated with existing memory structures.

Social Perception and Memory Consolidation

Once individuating information is integrated into existing memory structures, the information becomes accessible through its interconnectedness with other memories. This information then becomes easily generalized and categories are formed based on pre-existing stereotypes (McClelland et. al, 1995). By way of this integration of new memories with those preexisting, the newly formed memories become stronger and permanent through memory consolidation (McGaugh, 1966, 2000; Medina et. al, 2008; Spear & Mueller, 1984; Walker & Stickgold, 2006). This process of long-term memory formation has been argued to be involved in the development of declarative and episodic memories (Eichenbaum, 2001; Gais & Born, 2004; Gais et. al, 2002; Medina et. al, 2008). Following memory consolidation, the integration and association of episodic memories with semantic memories is strengthened (Ellenbogen et. al, 2007; Medina et. al, 2008; Spear & Mueller, 1984). This integration through consolidation is strengthened by protein synthesis and the replaying of these new memories to become integrated into long-term structures.

Provided that episodic memories are integrated with semantic memories through consolidation, it stands to reason that consolidation will also cause the integration of individuating information about a specific social target (i.e., episodic memories) with stereotypes (i.e., semantic memories). This integration occurs by way of new information about a group integrating with information about the group previously established. Therefore, it would make sense that stereotypic information does not simply disappear with the addition of individuating information. Rather, as memory consolidation theory argues, one would integrate the individuating information with the group information. For instance, learning that an individual has a trait that disconfirms stereotypes does not make one forget that the individual is a member of a learned social group. However, once this individuating information is integrated with the group information, the individual now becomes first known for their personal characteristics. Thus, while research has found that exposure to an individual without individuating information can increase rates of stereotypes; research has also focused on the malleability of stereotype inhibition (Kunda et. al, 2002; Locksley et. al, 1980; Moskowitz & Li, 2011; Park, 1986).

Despite the common notion that social categorization is an automatic and uncontrollable process, research demonstrates that stereotypes associated with categorization have malleability when invoking intentional, controlled efforts to inhibit expression of automatically activated stereotypes (Wheeler & Fiske, 2005). This social motivation may influence the activation of social perception as it provides some guidelines as to when expressing stereotypes is acceptable. This social motivation also includes the importance of acquiring additional information about an individual. The malleability of individuation within social perception is largely impacted by memory consolidation. The consolidation of individuating memories may lead to faster

associations with individuating information due to the newly learned individuating information becoming more accessible than stereotypic traits.

Previous research has merged memory consolidation research with social perception research (Enge et. al, 2015). Within this research, the mechanisms underlying prejudice formation was investigated by invoking a design which manipulated time between learning and test under the assumption that the long time delay included sleep (Enge et. al, 2015). However, the effects of time and sleep were not manipulated or isolated which then potentially leaves a number of questions still unanswered. The current study worked to answer those questions by extending this previous research with the use of exercise as a way to manipulate memory consolidation. This is important as exercise provides a more accessible measure of memory consolidation that can be experimentally manipulated in comparison to sleep (Roig et. al, 2012).

Manipulating Memory Consolidation

While research supports that the effect of time on memory retention may be attributed to memory consolidation processes acting during sleep (Mednick, Nakayama, & Stickgold, 2003; Peigneux, Laureys, Delbeuck, & Maquet, 2001; Racsmány, Conway, & Demeter, 2009; Rasch & Born, 2008; Rauchs, Desgranges, Foret, & Eustache, 2005; Scullin & McDaniel, 2010; Stickgold, Scott, Rittenhouse, & Hobson, 1999; Stickgold & Walker, 2013), previous research has also examined the effect of cardiovascular exercise on memory consolidation (Coles & Tomporowski, 2008; Roig et. al, 2012; Segal et. al, 2012; Siette et. al, 2014; Thomas et. al, 2016). The benefits of physical activity on brain function, brain health, and cognition are well documented and it has previously been demonstrated that an acute bout of exercise can positively affect memory (Colcombe et. al, 2004; Hillman et. al, 2008; Smith et. al, 2010; Thomas et. al, 2012).

The relationship between exercise and memory has been summarized in a meta-analysis by Roig and colleagues (2013) and the evidence points towards acute exercise having positive effects on long-term memory. Roig and colleagues (2013) showed cycling to be more effective in improving cognitive performance than treadmill running, and intensity to be critical to optimize memory and learning. More specifically, research suggests that acute high-intensity exercise may facilitate the consolidation of information into long-term memory (Coles & Tomporowski, 2008). The rationale behind the use of acute high-intensity exercise is usually founded upon psychological theories which postulate that an adequate level of exercise-induced arousal (Yerkes & Dodson, 1908) may optimize the allocation of mental resources and thus facilitate cognitive processing (Audiffren et. al, 2008) and consolidation of memory (McGaugh, 2006). Furthermore, acute exercise interventions allow for readily controlling and monitoring specific parameters (intensity, duration, modality) when investigating effects on memory. The duration of exercise also has a significant impact on the memory consolidation process (Segal et. al, 2012; Siette et. al, 2014). The exercise protocol used in the current study was similar to that from the studies of Roig et al. (2012) and Mang et al. (2014). As in past research, the total duration of the exercise was limited (20 min) in order avoid excessive fatigue and/or dehydration, which could have potentially had a negative effect on memory processing (Clan et. al, 2000; Grego et. al, 2005). It is also possible to control intensity within exercise; either relative to maximal oxygen uptake, maximum power output or age related maximum heart rate, among others.

The degree of intensity while exercising is a key factor for notable memory improvement (Thomas et.al, 2012). Recent work by Roig and colleagues (2012) investigated the effects of an acute high intensity (90% VO2 peak) exercise bout (cycling) on motor skill learning. The results

showed that a bout of high intensity exercise performed prior to motor skill acquisition had a significant positive effect not on skill acquisition, but on procedural memory assessed with delayed retention tests. However, while research has shown that acute high intensity exercise before or after the practice task can have a significant effect on memory as compared to a control group (Roig et al., 2012; Segal, Cotman, & Cahill, 2012; Mang et al., 2014), memory is significantly better if the acute high intensity exercise is performed after the practice task, during the early stages of memory consolidation (Roig et al., 2012). These studies add credence to the hypothesis that exercise intensity (and timing) is somehow intimately related to improvements in memory retention. The current study did not manipulate the intensity, duration, and timing of exercise, but instead used past research as a guide to explain why the intensity, duration, and timing of exercise chosen should work to facilitate memory consolidation of individuating information.

Overview and Hypotheses

The proposed research assessed the effect of memory consolidation on the automatic activation of racial stereotypes and the facilitation of individuating information about social targets. Specifically, we investigated whether an acute high intensity bout of cycling exercise could facilitate memory consolidation of individuating information. Based on the methods of previous research (Chavez, 2009), participants were first presented with individuating information about 12 social targets. The study then tested the degree to which the newly learned information was associated with the targets at two time points: once following exposure (referred to as the short delay test) and another 48 hours later (referred to as the long delay test). However, participants were randomly assigned into two groups, which either performed or did not perform an acute high intensity bout of cycling exercise following the short delay test.

By comparing responses between the short delay and long delay tests, one can test the effects of memory consolidation on person memory. The current study was designed to test the hypothesis that memory consolidation (manipulated via exercise) would facilitate the retrieval of recently learned individuating information. It was expected that individuating information would be accessed faster than stereotypic information after consolidation (i.e., within the long delay test).

For the novel targets, it was hypothesized that participants would respond faster to the stereotypic traits than to the individuating traits during the short delay test and the long delay test, as this is a replication of the classic stereotype priming effect (e.g., Blair & Banaji, 1996). It was also hypothesized that participants who engaged in exercise would exhibit faster associations to individuating traits of the learned targets than those who did not engage in exercise, and thus would have slower associations to stereotypic traits. Regardless of whether or not participants engaged in acute exercise, there should have been an overall demonstration of memory consolidation and faster associations to individuating traits due to the consolidation processes acting during sleep in both groups.

Method

Participants

Seventy-seven (N = 77) undergraduate introductory psychology students completed the experiment in return for partial course credit. A power analysis using G*Power (Faul et. al, 2007) indicated the need to have 68 participants to have 80% power for detecting a medium-sized effect when employing the traditional 0.05 criterion of statistical significance. However, after running a post-hoc power analysis, it was concluded that there was a need for a greater number of participants to have 80% power. To check whether the non-significant results were

due to a lack of statistical power, a post hoc power analyses was conducted using G*Power (Faul & Erdfelder, 1992; for a full description, see Erdfelder, Faul, & Buchner, 1996) which revealed the statistical power for this study was 0.07. This indicates that sample sizes need to increase in order for group differences to reach statistical significance at the .05 level.

Materials

Photo stimuli. A total of 24 male (12 Black and 12 White) frontal head and neck stimulus color photos were used within the experiment. Each stimulus photo was approximately 7 cm high and 6 cm wide. All photos were pilot-tested to ensure that the targets in the photos were not perceived as intimidating and had an average attractiveness rating. The individuals in the stimulus photos were from the same approximate age group (18-25) and did not have any major distinguishing features (e.g., glasses, facial hair).

The photos were randomly divided into 3 groups: 12 learned targets (6 Black males, 6 White males), 6 novel targets for the short delay test (3 Black males, and 3 White males), and 6 novel targets for the long delay test (3 Black males, 3 White males).

Trait stimuli. A total of 12 White male stereotypic traits, 12 Black male stereotypic traits, and 24 individuating traits were used in the experiment. All traits were pilot-tested to ensure that they were perceived as either racially stereotypic or neutral. During this pilot test, participants rated a number of personality traits as strongly associated with Black males, strongly associated with White males, or not strongly associated with either. In addition, 48 non-words (e.g., ciern, losri) were used within the experiment (24 in the short delay test and 24 in the long delay test). Traits and non-words were divided into 2 equivalent groups (i.e., 6 White male stereotypic traits, 6 Black male stereotypic traits, 12 individuating traits, and 24 non-words) and used as counter-balancing stimuli. Both sets of traits included an equal number of positive and

negative traits. The order in which the two sets of traits were used within the short and long delay tests were counter-balanced to ensure that participants were not exposed to the same word stimuli between the short and long delay tests.

Sentence stimuli. The 24 individuating (stereotype neutral) traits were also used to create 48 sentences (2 sentences per individuating trait) for use in the exposure task, split across two stimuli sets and counter-balanced. All of the sentences were structured in the first-person as if written by the targets themselves. Each sentence described how a target exemplifies each individuating trait and were pilot-tested to ensure that the sentences accurately described each individuating trait. For example, a target paired with the trait of honest included the sentence, "I never cheat on exams".

Questionnaires. Six questionnaires were administered within the current study: a demographic questionnaire, sleep check questionnaire, caffeine intake questionnaire, impression formation questionnaire, PAR-Q, and IPAQ.

PAR-Q. The PAR-Q is a physical readiness questionnaire comprised of 7-questions. This questionnaire is designed to identify adults for whom physical activity may be inappropriate or those who should have medical advice concerning the type of activity most suitable for them. When a person responds positively to 1 or more questions, they are referred to a physician for clearance. The PAR-Q has been shown to have sensitivity and specificity to criteria such as medical examination, hypertension, and exercise induced ECG abnormalities compare well with self-administered procedures (Warburton et. al., 2011). However, while the PAR-Q has been used internationally and extensively as a screening tool for physical readiness there are limitations. The primary limitation is its conservativeness leading to false positives and consequentially to unnecessary referrals for medical clearance.

IPAQ. The IPAQ is an instrument used to monitor physical activity and inactivity among 18- to 65-year-old adults in diverse settings. This questionnaire asks about the participant's time spent engaging in physical activity within the previous seven days. The IPAQ has undergone many tests to establish: test-retest reliability, concurrent validity, and criterion validity (Marshall et. al., 2003). Overall, the IPAQ questionnaire produced repeatable data (Spearman's ρ clustered around 0.8), with comparable data from the short and long forms. Criterion validity had a median ρ of about 0.30, which was comparable to most other self-report validation studies. The short form of the questionnaire was used in the current study. The questionnaire provided information on the time spent walking, sitting, and engaging in moderate and vigorous intensity activity. The short form was used because of its feasibility, and has been shown to have no difference in reliability and validity as compared to the long IPAQ form.

Procedure

Participants were recruited via an online system to participate in an experiment investigating the role of exercise on memory. All recruitment information informed participants that the experiment would involve 20 minutes of exercise. However, each experimental session was randomly assigned to one of the two consolidation group types (i.e., exercise vs. control). Furthermore, all sessions were limited to one participant per session.

At least 24 hours before the main experiment, participants reported to the laboratory to undertake a graded exercise protocol on a cycle ergometer. Upon arrival, participants were asked to provide government issued identification to verify that they were 18 or older. Participants were then asked to write down their age, birth month, and street name of their home address on the experiment information sheet. The age was used to calculate the maximum heart rate needed for the exercise protocol. The birth month and street name information was used as identifying

information to ensure the subject numbers remained consistent throughout the three experimental sessions. Participants first completed an informed consent (See Appendix A). Next, the participants completed the online demographic questionnaire (See Appendix B). This demographic questionnaire consisted of the IPAQ as well as questions pertaining to the participant's age, gender, race, height, weight, overall level of health, and tobacco usage. The participants then completed the printed PAR-Q questionnaire (See Appendix C). Once the participants finished with the beginning questionnaires, they began the graded exercise protocol.

The graded exercise protocol was used to determine the wattage at which the participant reached 70% of his or her maximum heart rate. Exercise started with a 5 min warm-up at a workload of 75W. After warm-up, the workload of the cycle ergometer was set at 100W and then gradually increased by 25W every 3 min until exhaustion. A Borg scale, ranging from 6 (no exhaustion) to 20 (complete exhaustion), was used to record the subjective level of perceived exertion at the end of each 3 min block by the participant indicating how hard they felt their body was working (See Appendix D). The participant's heart rate was monitored every 15 seconds and maximal heart rate was recorded. After the graded exercise protocol, the participant was be dismissed and reminded to return for their previously scheduled second session approximately 24 hours later.

Exposure task. Participants completed the computer-based portion of the experiment in a private computer lab. The exposure task consisted of a PowerPoint presentation and an impression formation questionnaire. The presentation included 12 learned target individuals (6 Black males and 6 White males) with one target presented per stimulus view. Each view included a target photo, the target's name, a sentence specifying the individuating trait paired with that target, and two sentences that served as examples of how the target exhibits the

individuating trait. The individuating traits and sentences paired with the learned targets were counter-balanced.

Each view was shown three times: once initially for 30 seconds and then twice for 15 seconds for a total of 1 minute of exposure per target. Overall, the exposure task took a total of 16 minutes and the order of the views was randomized within each exposure sequence. During the exposure task, participants were asked to study the information presented on each view and to form an impression of each target. Participants were also instructed to fill out the impression formation questionnaire about each learned target during the initial 30 seconds of exposure (See Appendix E). The impression formation questionnaire consisted of the participants indicating how much they liked the targets and the degree to which they felt the target was honest. After the exposure task, participants completed short delay filler tasks.

Short Delay Filler Tasks. In order to eliminate any short-term memory effects, participants completed two short and completely unrelated scales as a filler task. During this time, participants completed the Rosenberg Self-Esteem Scale (Rosenberg, 1965) and the Facebook Intensity Scale (Ellison, Steinfeld, & Lampe, 2007) (See Appendix F & G). Participants were told, however, that the scales are related to memory.

Short delay test. The short delay test took place immediately following the filler task. The short delay test was completed in SuperLab 4.0 software. Within this task, a blank screen was presented for 1000 ms. A fixation point (X) was then presented centrally on the screen for 500 ms. Next, a photo was presented centrally on the computer screen for 400 ms. A blank screen was then presented for 50 ms, and finally, the participants were presented with a letter string for 1500 ms or until the participant responded. Using a response pad, participants were

instructed to decide whether the presented letter string was a word or non-word as quickly and accurately as possible, by pressing the appropriately labeled keys.

The short delay test consisted of 1 practice block and 2 separate blocks of test trials with a 30 second break between each block. Within the practice block, a photo of either a banana or an apple was shown, followed by a letter string. The letter strings within the practice block were either a non-word or a non-trait word (i.e., school and house). Within the two testing blocks, half of the learned target photos were used (i.e., 6 of the learned 12 target photos) along with 6 novel target photos. Each target photo was tested with 4 trials: an individuating trait trial, a racial stereotype consistent trial, and two non-word trials. The individuating trait trials were traits that had been presented previously in the exposure task and were paired only with the matching learned target photos. Therefore, if a learned target photo was paired with the individuating trait of “driven” during the exposure task, the same target photo was only tested with the individuating trait of “driven”. The remaining individuating trait trials included 6 novel individuating traits and were randomly paired with novel target photos.

The racial stereotype consistent trials included 12 novel racial stereotypic terms that were randomly paired with both learned and novel target photos. All racial stereotypic terms were randomly paired with the corresponding race target photos. Finally, the non-word trials consisted of 24 randomly presented non-words. The third block was a replication of the second block with all trials in each block randomized. The short delay test consisted of 104 trials (including the 8 practice trials).

After the short delay test was completed, participants then either completed the exercise protocol or the control protocol depending on which group the session was previously randomly assigned.

Control Group Protocol. Within the control group sessions, participants were asked to complete two working memory tasks for 20 minutes. These tasks ensured that mental rehearsal of the information found within the exposure task was impossible. After 20 minutes, control group participants were then dismissed and reminded to return 48 hours later for the previously scheduled long delay test.

Exercise Group Protocol. After the participants completed the short delay test, participants within the exercise group were instructed to complete a 20-mintue block of exercise on a cycle ergometer in an adjacent room. High intensity was based upon each individual's heart rate during the graded exercise test protocol. Each individual's heart rate was calculated while they completed the beginning scales before the experiment began. The estimate of the participant's maximum heart rate was obtained by subtracting two hundred and seven from the product of the participant's age and 0.7 (Gellish et. al, 2007). The participant's heart rate was monitored throughout the exercise protocol and recorded every 30s, and the intensity was defined by a heart rate 70% of his or her maximum heart rate.

The 20-minute block of exercise included a 2-minute warm-up at a workload of 75W. After warm-up, the workload of the cycle ergometer was set to 100W and then gradually increased by 25W over approximately 3 minutes until the target heart rate was reached. The workload was adjusted by an electronically braked cycle ergometer based on pedal frequency to keep the watts constant. The participant was instructed to maintain a pedaling rate above 70 rpm throughout the entire protocol. The protocol consisted of three 3-minute segments of high intensity cardiovascular exercise with three two minute segments of low intensity exercise at a workload of 50W mixed between the high intensity segments. During the last 3 minutes of the exercise protocol the participant was allowed to perform a cool-down at a self-selected RPM. A

Borg scale, ranging from 6 (no exhaustion) to 20 (complete exhaustion), was also used to record the subjective level of perceived exertion at the end of each 3 min block.

After the 20-minute exercise protocol, the participant was dismissed and reminded to return for their previously scheduled final session approximately 48 hours later.

Long delay test. Approximately 48 hours after the exposure task, all participants returned for the final test session. The methods for the long delay test remained the same as used within the short delay test. However, the long delay test used the second half of the learned target photos along with 6 additional novel target photos. Due to the fact that the long delay test included different learned target photos, the 6 individuating traits that were matched with these targets during the exposure task were used within the individuating trait trials. As in the short delay test, the long delay test also randomly paired the 6 novel individuating traits within the individuating trait trial with only novel target photos. The racial stereotype consistent trials included 12 novel racial stereotypic terms that were paired randomly with both learned and novel target photos, and the non-words trials consisted of 24 randomly presented non-words. The testing stimuli that were used within the long delay test did not overlap or repeat any of the items used within the short delay test. The long delay test also consisted of 104 trials.

After completing the long delay test, participants completed the sleep check questionnaire and caffeine consumption questionnaire. The sleep check questionnaire consisted of the participants reporting whether they slept between sessions and, if so, rating the quality of their sleep (See Appendix H). The caffeine consumption questionnaire consisted of the participants self-reporting their consumption of caffeinated items between sessions, including cola, diet cola, pepper soda, citrus soda, other soda, tea (hot), iced tea, instant coffee, brewed coffee, other coffee, store-bought coffee, energy drink, other drink, food, and medications (See Appendix I).

After completion of the final questionnaires, participants were debriefed and dismissed (See Appendix J).

Results

The current study employed a mixed factorial design with a 2 (Consolidation Type: exercise vs. control) X 2 (Test Time: short delay test vs. long delay test) X 2 (Target Type: learned vs. novel) X 2 (Trait Type: stereotypic vs. individuating) repeated measures ANOVA in which test time, target type, and trait type were within-subject variables and consolidation type was a between-subject variable. Consistent with previous research (Zarate, Sanders, & Garza, 2000; Zarate, Stoever, MacLin, & Arms-Chavez, 2008), only correct response times (RTs) between 200 ms and 1000 ms were analyzed. RTs below 200 ms are considered too fast for participants to have correctly completed the task and RTs above 1000 ms are considered too slow to provide a valid assessment of processing speed. When the aggregate means were evaluated for normality, the response latencies produced a normal distribution.

These data were first analyzed within a 2 (Consolidation Type: exercise vs. control) X 2 (Time: short delay test vs. long delay test) X 2 (Target Type: learned vs. novel) X 2 (Trait Type: stereotypic vs. individuating) repeated measures ANOVA with RTs serving as the dependent variable. This analysis failed to produce the expected Consolidation Type X Time X Target Type X Trait Type interaction, $F = .12$, *ns*. This analysis did produce main effects which were all subsumed under a significant 3-way interaction that included Time X Target Type X Trait Type, $F= 4.44$, $p < .05$. Because a primary focus of this study was the impact of consolidation on social perceptions, this 3-way interaction was decomposed by analyzing the short delay and long delay tests separately to identify differences across time.

The short delay test revealed a significant Target Type X Trait Type interaction, $F = 8.78$, $p < .01$. As predicted, participants responded significantly faster to the stereotypes with new targets ($M = 604$, $SD = 113$) than to the individuating traits associated with the new targets ($M = 625$, $SD = 125$; $F = 12.73$, $p < .001$). On the other hand, the responses were not significantly different between the stereotype traits ($M = 610$ ms, $SD = 119$) and the individuating traits ($M = 594$ ms, $SD = 117$) associated with the exposure targets, $F = .94$, *ns*. This finding fails to replicate previous research showing greater priming between a target and stereotypic traits than between other types of information (e g., Blair & Banaji, 1996).

The long delay test failed to produce the predicted Target Type X Trait Type interaction, $F = .86$, *ns*. It was predicted that responses to the individuating traits associated with the exposure targets would be enhanced with the time and consolidation. Contrary to predictions, for both new and exposure targets, there was a significant Trait Type main effect, $F = 5.62$, $p < .05$. During the long delay test, participants responded to the individuating traits faster ($M = 573$ ms, $SD = 103$) than to the stereotypic traits ($M = 583$ ms, $SD = 114$). Therefore, participants were faster to process individuating information for both new and exposure targets.

Discussion

This study addressed two main questions: first, can a single bout of intense exercise facilitate the retrieval of recently learned individuating information? Second, would participants respond faster to the stereotypic traits than to the individuating traits during the short delay test and the long delay test? With regards to the first question, the results suggest that single bout of exercise does not have any significant effect on person memory. With regards to the second question, the results did not support the hypothesis that individuating information would be activated prior to stereotypes when associated with previously encountered (i.e., exposure)

targets and had time to become consolidated. Since the results also show a facilitation effect for novel targets, this study does not support previous research showing that repeated exposure to individuating information over time leads to an automatic activation of that associated information. There are two reasons why this study cannot conclude that time or consolidation facilitated the individuating information for the exposure targets. First, within the short delay test, there was no significant difference between the stereotype and the individuating traits. This is a problem because the trend suggests that the individuating information was already starting toward facilitation during the first test without any consolidation (sleep or exercise) that day. Second, the long delay test demonstrates that participants were now faster to respond to all individuating information even when they had not consolidated some of it at all. The new targets and the associated individuating information were completely new to participants within the long delay test. They had not been exposed to any of that information before. Yet, participants were just as fast to respond to the brand new individuating information as they were the exposed/learned individuating information. Thus, although the results suggest a facilitation effect, we cannot conclude it is due to consolidation necessarily.

Limitations & Future Research

This research is not without its limits. In this study, the bout of exercise performed after the short delay test did not show to significantly effect the long-term retention of the individuating information. This result conflicts with a recent study which assessed the effects of acute exercise performed at different time points on verbal memory (Labban & Etnier, 2011). In this study the authors investigated the effects of moderate aerobic exercise performed either before or after listening to two paragraphs on the recall performance of these two paragraphs assessed after exposure. In comparison to a non-exercise control group, the group that exercised

prior to exposure showed a significantly greater recall of words during retention although differences between exercise groups were not statistically significant. A possible explanation for the discrepancy between these results and our results might be the necessity of a greater number of participants to increase the power of the current study. Thus, it is likely that our negative findings can be attributed to a limited sample size. Another possibility for the discrepancy is that the intense bout of exercise somehow prompted participants to be more aware of individuating information.

It is also important to note that while the current study suggested evidence of a facilitation of individuation, it did not find any evidence of stereotype inhibition, as responses to stereotypic traits did not differ across test time. In a sense, this is not surprising. After all, impressions can only be generated using the information individuals have available to them. First impressions are generally limited to the readily accessible stereotypic information based on physical or behavioral characteristics. Yet, it is more socially beneficial to view others as individuals and to avoid labeling others in a stereotypic manner. In fact, individuals actively try to refrain from judging others solely on the basis of stereotypic information (Yzerbyt, Schadron, Leyens, & Rocher, 1994). This social motivation may influence the activation of social perception as it provides some guidelines as to when expressing stereotypes is acceptable. This social motivation also includes the importance of acquiring additional information about an individual. However, stereotypic information cannot be merely forgotten or ignored as some of that information may still be viable towards forming an impression. While stereotypes are overgeneralizations, some stereotypic information may still be useful. Therefore, it would make sense that stereotypic information does not simply disappear with the addition of individuating information. Individuation does not necessarily mean inhibiting or eliminating all stereotypic

information as some of that information remains an important part of our impressions. Instead, we now have a more complete impression due to the integration of the learned individuating information with the stereotypic information.

Conclusion

Based on the results, it cannot be concluded that learning personal information about a social target may facilitate responding to that social target after completing a single bout of intense exercise and after a time delay containing the opportunity to sleep. With repeated exposure to personal information, participants access person memories (individuation) significantly faster than group memories (stereotypes) for both new and exposure targets. Thus, it cannot be concluded that even given individuating information and repeated exposure over time, individuation is facilitated. More participants are needed to investigate whether the exercise condition alone may facilitate memory consolidation of personal information.

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Appendix A

Informed Consent

Concerning Participation in a Research Study
for Memory and Social Perception
Auburn University at Montgomery
Psychology Department

You are invited to participate in a study of memory and social perception. We hope to learn how memory processes may influence how we perceive individuals. You are being asked to volunteer to be in this study because you are in the enrolled in an Introductory Psychology course. If you agree to take part in this study, your involvement will last no longer than 2 hours over a period of 3 days. If you agree to take part in this study, you will be asked to complete two computerized tasks as well as complete a small demographic questionnaire and five separate questionnaires. On the first day, you will be asked to complete a graded exercise protocol. On the second day, you will be asked to complete the first computerized task and then return 48 hours later to complete the second computerized task. There are no known risks associated with this research. While there will be no direct benefits to you for taking part in this study, it is anticipated that you will gain some educational benefit from participating in this study. At the end of the study, an explanation will be offered to you. You should gain a greater understanding of how psychological research is conducted, and types of research conducted at AUM.

You have the option not to take part in this study. There will be no penalties involved if you choose not to take part in this study. If you choose to take part, you have the right to stop at any time.

Your part in this study is anonymous. None of the information will identify you by name. All records are maintained in locked filing cabinets or secure internet servers. Anonymity will be maintained by ensuring that there is no way to connect participant's responses with their personal information. Results will be reported as an aggregation of data and there will be no way to connect individual responses with participants in any way. Upon completion of the study the informed consent and debriefing forms will be stored in a locked file cabinet.

Your decision whether to participate will not prejudice your future relations with Auburn University at Montgomery. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without penalty. If you decide later to withdraw from the study, you may also withdraw any information that has been collected about you. Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact the investigator, Dr. Clarissa Arms-Chavez, by phone (334-244-3595) or via email (cchavez@aum.edu). If you have any questions about your rights as a volunteer in this research, contact Debra Tomblin, Research Compliance Manager, AUM, by phone (334-244-3250)or via email (dtomblin@aum.edu). We will give you a copy of this consent form to take with you.

Authorization Statement

I have read each page of this paper about the study (or it was read to me). I know that being in this study is voluntary and I choose to be in this study. I know I can stop being in this study without penalty. I will get a copy of this consent form now and can get information on results of the study later if I wish.

YOU ARE MAKING A DECISION WHETHER TO PARTICIPATE. YOUR SIGNATURE INDICATES THAT YOU HAVE DECIDED TO PARTICIPATE, HAVING READ THE INFORMATION PROVIDED ABOVE.

Participant Name: _____ Date: _____

Participant Signature: _____ Time:_____

Explained/witnessed by: _____

(Researcher Signature)

Researcher's Printed Name: _____ Date: _____

Participant's Course Instructor: _____

Appendix B

Demographic Questionnaire

1. What is your gender?

2. What is your age?

3. What is your race?
    a. White, White non-Hispanic, African-American, Hispanic, Asian-Pacific Islander, Native American, Other (specify)

4. What state were you primarily raised in?

5. Do you currently have any condition not listed above that may influence our results or your participation?

    _____
    _____

6. Indicate your overall level of health:

    a. Excellent

    b. Good

    c. Fair

    d. Poor

7. Do you now or have you ever used tobacco? Yes❑ No ❑

    How long? _____ Quantity _____/day

    Years since quitting _____

****

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active

in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.
Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week
No vigorous physical activities ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ hours per day
_____ minutes per day
Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

No moderate physical activities ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ hours per day
_____ minutes per day
Don't know/Not sure
Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?
_____ days per week

No walking ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ hours per day
_____ minutes per day
Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ hours per day
_____ minutes per day
Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

Appendix C
PAR-Q

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
☐	☐	**1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
☐	☐	**2. Do you feel pain in your chest when you do physical activity?**
☐	☐	**3. In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	**4. Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	**5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	**6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	**7. Do you know of any other reason why you should not do physical activity?**

If you answered YES to one or more questions:

- Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.
- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

If you answered NO to all questions

- If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- Start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- Take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

NAME _____

SIGNATURE _____

DATE _____

WITNESS _____

Appendix D
Rating of Perceived Exertion (RPE) Category Scale

6

7 Very, very light

8

9 Very light

10

11 Fairly light

12

13 Somewhat hard

14

15 Hard

16

17 Very hard

18

19 Very, very hard

20

Appendix E
Impression Formation Questionnaire

Carol

1. How friendly do you think **Carol** is?

1	2	3	4	5
Not at all Friendly	*Slightly Friendly*	*Moderately Friendly*	*Mostly Friendly*	*Extremely Friendly*

2. How personable do you think **Carol** is?

1	2	3	4	5
Not at all personable	*Slightly*	*Moderately*	*Mostly*	*Extremely personable*

3. How much do you like **Carol**?

1	2	3	4	5
Not at all	*Slightly*	*Moderately*	*Mostly*	*Extremely*

4. How willing would you be to hang out with **Carol**?

1	2	3	4	5
Not at all	*Slightly*	*Moderately*	*Mostly*	*Extremely*

****

David

1. How friendly do you think **David** is?

1	2	3	4	5
Not at all Friendly	*Slightly Friendly*	*Moderately Friendly*	*Mostly Friendly*	*Extremely Friendly*

2. How personable do you think **David** is?

1	2	3	4	5
Not at all personable	*Slightly*	*Moderately*	*Mostly*	*Extremely personable*

3. How much do you like **David**?

1	2	3	4	5
Not at all	*Slightly*	*Moderately*	*Mostly*	*Extremely*

4. How willing would you be to hang out with **David**?

1	2	3	4	5
Not at all	*Slightly*	*Moderately*	*Mostly*	*Extremely*

Appendix F
Rosenberg Self-Esteem Scale

Instructions: Below is a list of statements dealing with your general feelings about yourself. Please indicate how strongly you agree or disagree with each statement.

1. On the whole, I am satisfied with myself.
Strongly Agree Agree Disagree Strongly Disagree

2. At times I think I am no good at all.
Strongly Agree Agree Disagree Strongly Disagree

3. I feel that I have a number of good qualities.
Strongly Agree Agree Disagree Strongly Disagree

4. I am able to do things as well as most other people.
Strongly Agree Agree Disagree Strongly Disagree

5. I feel I do not have much to be proud of.
Strongly Agree Agree Disagree Strongly Disagree

6. I certainly feel useless at times.
Strongly Agree Agree Disagree Strongly Disagree

7. I feel that I'm a person of worth, at least on an equal plane with others.
Strongly Agree Agree Disagree Strongly Disagree

8. I wish I could have more respect for myself.
Strongly Agree Agree Disagree Strongly Disagree

9. All in all, I am inclined to feel that I am a failure.
Strongly Agree Agree Disagree Strongly Disagree

10. I take a positive attitude toward myself.
Strongly Agree Agree Disagree Strongly Disagree

Scoring:
Items 2, 5, 6, 8, 9 are reverse scored. Give “Strongly Disagree” 1 point, “Disagree” 2 points, “Agree” 3 points, and “Strongly Agree” 4 points. Sum scores for all ten items. Keep scores on a continuous scale. Higher scores indicate higher self-esteem.

Appendix G
Facebook Intensity Scale

The Facebook Intensity scale is used to measure Facebook usage beyond simple measures of frequency and duration, incorporating emotional connectedness to the site and its integration into individuals' daily activities. You are free to use the Facebook intensity scale (FBI) as long as correct attribution is used.

Citation:
Ellison, N. B., Steinfield, C., & Lampe, C. (2007). The benefits of Facebook "friends:" Social capital and college students use of online social network sites. *Journal of Computer-Mediated Communication, 12*, 1143-1168.

Scale Items:
1. Facebook is part of my everyday activity
2. I am proud to tell people I'm on Facebook
3. Facebook has become part of my daily routine
4. I feel out of touch when I haven't logged onto Facebook for a while
5. I feel I am part of the Facebook community
6. I would be sorry if Facebook shut down

** Response categories (for items 1 – 6) range from 1 = strongly disagree to 5 = strongly agree

7. Approximately how many TOTAL Facebook friends do you have?
   - 10 or less
   - 11-50
   - 51-100
   - 101-150
   - 151-200
   - 201-250
   - 251-300
   - 301-350
   - 351-400
   - More than 400

8. In the past week, on average, approximately how much time PER DAY have you spent actively using Facebook?
   - Answers in 15 minute intervals ("0-15" to "More than 1 hour and 30 minutes")

Computing the Scale
The Facebook Intensity score is computed by calculating the mean of all of the items in the scale.

Appendix H
Sleep Check Questionnaire

Your answers to the following questions will not affect your participation in the study, so please answer them honestly.

1. **During the 2 day break, how many hours (approximately) did you sleep the FIRST night?**

0 1 2 3 4 5 6 7 8 9 10+

1a. On a scale from 0 to 100, 0 being not at all refreshing/restorative and 100 being very refreshing/restorative, please circle how refreshing/restorative this sleep was.

0 10 20 30 40 50 60 70 80 90 100

Not at all Restorative Very Restorative

2. **During the 2 day break, how many hours (approximately) did you sleep the SECOND night?**

0 1 2 3 4 5 6 7 8 9 10+

2a. On a scale from 0 to 100, 0 being not at all refreshing/restorative and 100 being very refreshing/restorative, please circle how refreshing/restorative this sleep was.

0 10 20 30 40 50 60 70 80 90 100

Not at all Restorative Very Restorative

Appendix I
Caffeine Consumption Questionnaire

Please complete the questionnaire below concerning your caffeine usage. List the number of times you consume the following substances during a -week. You will be provided with the number of milligrams of caffeine per substance for calculating your weekly caffeine intake.

	Average number of ounces/doses/tablets per day	**Average total per day**
Beverages		
Coffee (6 oz.)		
Decaf Coffee (6 oz.)		
Coffee (6 oz.)		
Decaf Coffee (6 oz.)		
Espresso (1 oz.)		
Tea (6 oz.) Green		
Tea (6 oz) Black		
Cocoa (6 oz.)		
Energy drinks (12 oz.)		
Caffeinated Soft Drinks (12 oz.)		
Chocolate candy bar		
Over-the-Counter Medications		
Anacin		
Appetite-control pills		
Dristan		
Excedrine		
Midol		
NoDoz		
Triaminicin		
Vanquish		
Vivarin		

*Caffeine content of energy drinks vary. They also include a number of stimulating herbs. > 250 milligrams a day, if taken after noon, may interfere with deep sleep ® John Preston (2014)

Appendix J
Debriefing Form

Debriefing form: Memory & Social Perception

First of all, the names and traits that you have learned for the photographed individuals are not necessarily true. We have no knowledge as to their true names and personalities.

Within this experiment, we were testing the effects of exercise and memory on social perception. You were asked to come in three separate times over a period of three days in order to test this effect. During the process of memory consolidation, your brain will switch the short-term memory into a long-term memory store. So, over the 48 hour break, we gave your brain time to switch the information you had learned about the target individuals to a long-term memory store. We have found in previous research that memory consolidation slows social categorization. Therefore, when people learn some individuating or unique information about an individual and this information is given time to consolidate people are slower to categorize that individual solely as an African-American or European American because they've become familiar with them. Your participation in the current research will help us learn more about the influence of time and memory on social perception. In addition, your participation will help us better understand this important social phenomenon.

It is important to remember that your data is kept completely anonymous and there will be no way for us to associate your responses with you individually. It is a part of an aggregation of data. Nonetheless, if you prefer that your data be excluded from the experiment, please notify the researcher right now.

If, at a later time, you would like more information about the topics covered in this research, or an opportunity to talk about the feelings and thoughts brought up by participating in this research, you may contact Dr. Clarissa Arms-Chavez (cchavez@aum.edu or 244-3595).

Do you have any questions for me now? If so, please ask!

Since the true purpose of this study was masked for experimental purposes, it is your right to have your own data excluded from the analysis. If that is the case, you may notify the experimenter. **Please do not share any information about this experiment with anyone else as this would drastically hurt our results!**

If you are comfortable included your data in our analyses please sign here:

_____

Experimenter signature:

_____