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The effect of arm crossing on persistence and performance

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Abstract

Two experiments investigated the hypothesis that arm crossing serves as a proprioceptive cue for perseverance within achievement settings. Experiment 1 found that inducing participants to cross their arms led to greater persistence on an unsolvable anagram. Experiment 2 revealed that arm crossing led to better performance on solvable anagrams, and that this effect was mediated by greater persistence. No differences in comfort, instruction adherence, or mood were observed between the arms crossed and control conditions, and participants appeared to be unaware of the effect of arm crossing on their behavior. Implications of the findings are discussed in terms of the interplay between proprioceptive cues and contextual meaning. Copyright © 2007 John Wiley & Sons, Ltd.

More often than not, Pat Riley, coach of the National Basketball Association's Miami Heat, can be seen during a game pacing the sidelines wearing a highly distinctive pose. Arms crossed tightly around his chest, chin jutting outward and shoulders spread wide, the seven-time title holder's nonverbal signal could not be clearer: 'I am going to persevere.' But is Pat Riley's posture more than just an outward signal of perseverance? That is, does the position of one's body also inform subjective experience, consequently influencing behavior?

Nonverbal behaviors represent an important component of human communication. Facial expressions, hand gestures, and bodily postures have all been shown to play an integral role in the way that individuals convey their thoughts, feelings, and intentions to others (DePaulo & Friedman, 1998). In addition to serving an expressive function, body positions and movements also contain information regarding one's own experiential state (Barsalou, Niedenthal, Barbey, & Ruppert, 2003; Cacioppo, Priester, & Bernston, 1993; Strack, Martin, & Strepper, 1988). That is, these proprioceptive cues act as embodied manifestations of an underlying subjective experience.

Theories linking physical movement with subjective experience date back to Darwin (1872/1965), who argued that motor movements are a central component of attitude. Darwin also believed that an individual's emotional expression affects his or her emotional state (see also James, 1890). Recent studies have confirmed the connection between body position and psychological states; self-produced bodily cues have been shown to elicit corresponding affects, attitudes, and evaluative judgments

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(Cacioppo et al., 1993; Friedman & Förster, 2000; Laird, Wagener, Halal, & Szegda, 1982; Neumann & Strack, 2000).

In the present research, we investigated an unexplored proprioceptive cue and its influence on behavior within achievement settings. Specifically, we hypothesized that the experience of arm crossing would serve to direct people's behavior by activating associations related to perseverance. To elucidate the means by which body positions influence psychological processes, we begin by overviewing the existing literature on proprioceptive cues. Following this review, we turn to an examination of arm crossing as a proprioceptive cue, highlighting the importance of contextual meaning on subjective experience. We then report findings from two experiments that tested our hypothesis regarding the influence of arm crossing on achievement behavior.

RESEARCH ON PROPRIOCEPTIVE CUES

Over the past quarter century, the impact of body positions and movements on psychological functioning has garnered increasing scholarly attention. Building on research showing that facial expressions influence self-reported affect, Laird et al. (1982) demonstrated that emotion-relevant facial expressions also improved recall of hedonically consistent material. Strack et al. (1988) refined the procedure for inducing facial manipulations by providing participants with a cover story that prevented them from identifying the emotional relevance of their expressions. Their research showed that participants induced to simulate smiling (by holding a pen with their teeth) rated cartoons as funnier than did participants in two control conditions.

Next, researchers turned to the question of whether bodily cues could also activate 'nonemotional' feelings, defined as experiences not characterized by positive or negative valence. Examples of 'nonemotional feelings' include the experience of effort and familiarity (Clore, 1992). To test this possibility, Stepper and Strack (1993) induced participants to either contract their corrugator muscle (i.e., furrow their brow) or their zygomaticus muscle (i.e., adopt a slight smile); furrowing the brow was presumed to be associated with the experience of expending effort. Findings revealed that self-reported effort was indeed influenced by the proprioceptive cue of contracting the corrugator muscle, such that those with furrowed brows reported having exerted effort to a greater extent.

Nonfacial proprioceptive cues have also been found to impact psychological processing. Wells and Petty (1980), for example, showed that motor movements can affect attitudinal persuasion. Participants asked to move their head either horizontally or vertically, while listening to an editorial, differed in the degree to which they agreed with the message they heard. Nodding participants were more likely to endorse the content of the editorial, suggesting that the propriceptive cue of vertical head movement facilitated attitudinal agreement. Förster (2004) obtained a similar finding using a more subtle manipulation to induce participant head nodding and shaking. Participants were presented with various consumer products moving across a computer screen, either vertically or horizontally, and asked to evaluate each item. Positively valenced products were evaluated more positively when presented vertically, suggesting that induced head nodding led to greater liking for the product.

To date, the proprioceptive cue that has attracted the most research attention is arm flexion and extension. Based on the theorizing of James (1884), Cacioppo et al. (1993) conducted a series of experiments showing that attitude formation is influenced by arm movement. By instructing participants to either press upward (arm flexion) or downward (arm extension) against a table, Cacioppo and colleagues succeeded in activating associations related to approach and avoidance motivation, respectively, consequently impacting judgments of neutral stimuli. According to Cacioppo et al. (1993), the influence of arm movement on cognitive functioning is grounded in learning theory.

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Through years of experience, motor actions directed toward the self become linked with the acquisition of desired stimuli. In contrast, motor actions directed away from the self become linked with the rejection of undesirable stimuli. Subsequent arm flexion and extension work has produced further evidence consistent with this view. For instance, arm flexion and extension have also been shown to facilitate the processing of positive and negative words, respectively (Neumann & Strack, 2000). Likewise, Chen and Bargh (1999) used a push versus pull motor manipulation to show that participants responded to positively valenced words more quickly while flexing, and to negatively valenced words more quickly while extending. Furthermore, in a series of studies, Friedman and Förster (2000, 2001) demonstrated that arm flexion and extension movements lead to the adoption of differing cognitive processing styles. Arm flexion was shown to facilitate the use of an open, flexible processing style in a creativity context, whereas arm extension was shown to facilitate the use of a more restrictive, inflexible processing style.

Research linking proprioceptive cues with cognitive processing styles suggests that proprioceptive cues may also elicit specific behavioral tendencies. That is, the adoption of certain body positions may predispose people to pursue related behaviors. Over time, the repeated pairing of certain body positions with specific behaviors may link them together in memory, such that the occurrence of one automatically triggers the other. In the present research, we argue that proprioceptive cues activate specific behavioral tendencies with which the cues have been linked in the past. To test this hypothesis, we investigated the impact of an unexplored proprioceptive cue on behavior. Specifically, we induced participants to adopt a body position associated with perseverance, and tested whether it would increase perseverance-related behavior.

ARM CROSSING AS A PROPRIOCEPTIVE CUE

Arm crossing is a bodily cue that has received a good deal of attention in the nonverbal communication literature (Argyle, 1988; Bull, 1983). Numerous interpretations have been proposed about the message conveyed by arm crossing, with some arguing that it is perceived as a signal of defensiveness and rejection (Argyle, 1988; Fast, 1970), and others reporting that it is associated with vigilance and an unyielding attitude (Bull, 1987; Spiegel & Machotka, 1974).

Although these findings may seem somewhat incongruous at first, we propose that both are plausible given the appropriate context. As Argyle (1988) points out, in order to discern the meaning of a nonverbal signal, the structure of the situation must be known. The significance of a man raising both hands in the air, for example, will carry vastly different meaning depending on whether he is a war zone refugee, or a dancer at a nightclub.

A parallel argument can be made for the subjective influence of bodily cues. A recent paper by Tamir, Robinson, Clore, Martin, and Whitaker (2004) illustrates that nonconscious expressive cues can lead to opposite evaluations, depending on the context in which they occur. For example, head shaking was shown to either increase or decrease prosocial affect for a target, depending on whether the target was presented as living amidst unfortunate circumstances or as potentially guilty of a crime. When presented with a target expressing the misery of her situation, head shaking produced *greater* prosocial affect, whereas head shaking produced *lower* prosocial affect when participants were exposed to a target denying a past transgression. In other words, there is an inherent flexibility in the way proprioceptive cues are interpreted, with context moderating subjective meaning. The significance of bodily movements, therefore, can only be fully evaluated when situational context is taken into account.

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Within achievement contexts, we argue that arm crossing holds a specific meaning, serving as a bodily cue associated with perseverance. Arm crossing tends to occur *in situ*ations where people are working hard to solve a problem or accomplish a task, and are determined to continue until successful completion. With repeated experience, arm crossing in achievement settings is presumed to become deeply linked with a behavioral tendency to persevere. As such, over time, the act of arm crossing in achievement contexts should activate a perseverant behavioral tendency, and this should occur without intention or awareness.

To date, no study has investigated arm crossing as a proprioceptive cue. The research that is most closely related to the present work is a study testing the influence of posture on helplessness behavior. Riskind and Gotay (1982) manipulated participants' posture by having them either sit in a 'slumped, depressed' position, or an 'expansive, upright' position. Results showed an effect for posture, with participants instructed to sit in a slumped/depressed posture showing signs of helplessness, relative to those instructed to sit in an expansive/upright posture. Riskind and Gotay (1982) argued that their results could be explained by self-perception theory, which assumes that people make conscious inferences about their overt behavior (Bem, 1967). Proprioceptive effects, on the other hand, are thought to take place without participants being aware of the experimental manipulation and/or its intended purpose (see Strack et al., 1988).

In short, we predicted that participants induced to cross their arms would persist longer at an achievement task. Furthermore, given that persistent effort commonly yields positive outcomes, we also predicted that participants induced to cross their arms would not only persist longer, but would also perform better as a function of their persistence. Two experiments tested these hypotheses, while examining several alternative explanations regarding the impact of arm crossing on behavior.

EXPERIMENT 1

In this experiment, we tested the hypothesis that inducing participants to cross their arms in an achievement context would lead them to persist longer on an achievement task. Participants were instructed to place their arms in one of two positions, and were presented with an anagram task. Our dependent measure consisted of persistence on an unsolvable anagram.

Method

Participants and Design

Forty-one (5 male and 36 female) undergraduates participated in an experiment on 'Body Movement and Intelligence' in return for course credit. Random assignment was used in designating participants to one of two experimental conditions, the arms crossed condition or the arms-on-thighs condition.

Procedure

Participants were run individually by experimenters blind to hypothesis. After signing a consent form, participants were read a cover story designed to prevent self-perception effects (Friedman & Förster, 2001; Olson & Hafer, 1990). Self-perception effects arise when inferences are made regarding an observed behavior, and we sought to prevent this occurrence by providing participants with a false

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explanation for arm positioning, diverting them from inferring that arm crossing was used to activate associations related to perseverance. Using a modified version of a cover story designed by Friedman and Förster (2000), participants were told:

> This study tests the effects of motor activity on analytical reasoning abilities. More specifically, we're trying to understand the relationship between arm movement and analytical processing. There's been an ongoing debate, with some people saying that arm movement helps this type of processing and others saying that arm movement disrupts this type of processing. We are testing this in our study.

All participants were then informed that they had been randomly assigned to the stationary arm condition, and were asked to sit with their back straight against the chair's plastic support, keeping both hands flat on the table in front of them.

Following these instructions, participants were presented with a practice anagram booklet. The practice booklet featured instructions for the anagram task as well as two sample items with solutions. The task contained a total of three anagrams; the first two were easily solvable ('KAMR' and 'REAWT'), and the final anagram was unsolvable ('SERVOLK'). Participants were directed to use *all* letters when writing a solution.

Participants were asked to remain seated with their backs straight against the chair and their hands flat on the desk throughout the practice exercise, only lifting their hands when they were ready to write a solution or needed to turn the page. Participants were also instructed to resume their previous arm position once they had written a solution or turned the page. There was no time limit for the practice exercise.

Participants were then instructed to begin. The experimenter used a stopwatch to surreptitiously record the amount of time participants worked on the final, unsolvable, anagram. This provided a pre-manipulation measure of persistence.

Next, participants were asked to place their arms in a different position, and it was here that the manipulation was introduced. Participants in the arms crossed condition were told to close both hands and cross their arms, as demonstrated by the experimenter. Control condition participants were instructed to close both hands and place their arms over their thighs, as demonstrated by the experimenter. Participants in both conditions were asked to close their hands in order to standardize hand position across condition, and to control for the possibility that participants with crossed arms may be more likely to spontaneously close their hands. Following the arm position induction, participants in both conditions were reminded to keep their backs straight against the chair and to keep their arms in the set position, only lifting them when they were ready to answer an item or turn the page.

The anagram task was then presented. Like the practice exercise, the test portion of the experiment contained three items. The first two anagrams were again easily solvable ('WODN' and 'TOBOR'), and the final anagram was unsolvable ('OCHERSTE'). Participants were told that they had as much time for the task as needed. The experimenter unobtrusively timed how long participants persisted on the unsolvable item. In addition, the experimenter monitored how well participants followed the arm position instructions, and rated their adherence on a 1 (*not at all well*) to 7 (*very well*) scale.

Following the task, participants completed a brief demographics survey and a question regarding the degree to which the arm position felt *comfortable* during the session (1 = *very uncomfortable* to 7 = *very comfortable*). This item was designed to address an alternative explanation for the predicted effect; specifically, that greater persistence was simply due to a higher comfort level in the arms crossed condition.

Lastly, participants received a funnel debriefing that probed for suspicion (e.g., 'Did anything seem unusual or strange to you during the experiment?') and awareness (e.g., 'What do you think this study

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was trying to test?'), consistent with the method outlined by Bargh and Chartrand (2000). This allowed us to examine whether participants were conscious of the role of arm position on persistence.

Results and Discussion

Preliminary analyses were conducted to test for a main effect of gender. Gender was not significant in any of these analyses, and was not considered further. In order to control for participants' general ability, grade point average (GPA) was utilized as a covariate in all analyses.

Simultaneous multiple regression analysis was used to examine the relationship between arm position and persistence, controlling for pre-manipulation persistence ($M = 84.4$, $SD = 88.5$) and general ability ($M = 3.36$, $SD = 0.40$). The experimental contrast compared the arms crossed condition (+1) with the arms-on-thighs control condition (−1). The analysis revealed a significant effect for pre-manipulation persistence, $F(3, 37) = 10.88$, $p < .003$ ($\beta = .45$), indicating that the longer participants persisted on the practice exercise, the longer they persisted on the unsolvable anagram. The general ability effect was not significant, $F(3, 37) = 2.24$, $p > .14$. Most importantly, the analysis also revealed an effect of arm position on anagram persistence, $F(3, 37) = 5.86$, $p < .03$ ($\beta = .35$). Participants in the arms crossed condition continued working on the unsolvable anagram longer than did participants in the arms-on-thighs condition (see Figure 1).

No difference in instruction adherence was found between the two conditions ($t = 0.57$, $p > .57$), and participants in the two conditioned reported comparable levels of comfort ($t = -0.66$, $p > .51$). Independently controlling for these variables did not alter the central finding, $F(4, 36) \geq 5.78$, $p < .03$, indicating that greater persistence in the arms crossed condition was not due to differences in instruction adherence or participant comfort. In addition, in the funnel debriefing, not a single participant expressed suspicion or awareness that the experiment was focused on arm position and persistence.

In sum, the results of this experiment provide support for our hypothesis that within achievement settings, arm crossing generates a behavioral tendency to persevere. Participants instructed to cross their arms persisted longer at an unsolvable anagram than those in a control condition.

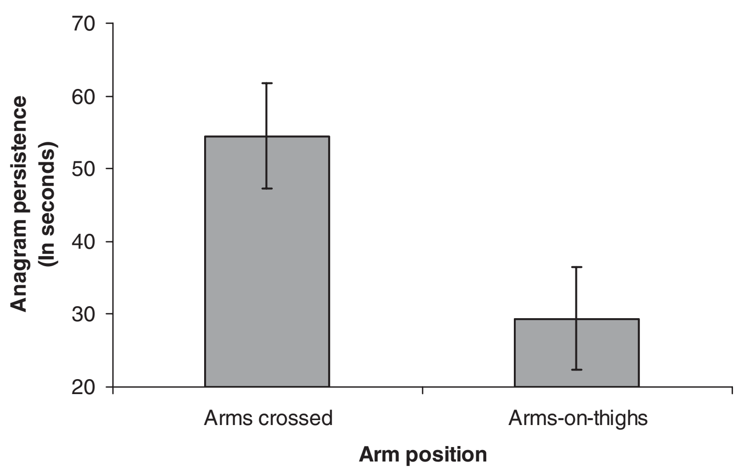

Figure 1. The effect of arm position on anagram persistence in Experiment 1: Mean number of seconds working on the unsolvable anagram by arm position (means are adjusted for general ability and pre-manipulation persistence). Arms crossed participants persisted for significantly longer ($p < .05$) than arms-on-thighs participants

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EXPERIMENT 2

Experiment 2 examined whether the proprioceptive activation of perseverance would lead to improved task performance as well as persistence. Given that our first experiment found that arm crossing led to increased persistence, we hypothesized that arm crossing would also facilitate improved performance on a task in which persistence is beneficial. To test this prediction, we modified a measure used by Förster, Higgins, and Idson (1998), in which participants were instructed to provide as many words as possible for anagrams with multiple solutions. In contrast to our first experiment, in which the target anagram was unsolvable, in this experiment all anagrams were solvable and of moderate difficulty. Therefore, this anagram task was able to assess both the degree to which people persisted on the task, and the number of anagrams solved.

Method

Participants and Design

Thirty-eight (9 male and 29 female) undergraduates participated in an experiment on 'Body Movement and Intelligence' in return for course credit.[1] Random assignment was used in designating participants to one of two experimental conditions, the arms crossed condition or the arms-on-thighs condition.

Procedure

Using C++, we designed a computer program to present participants with three pre-manipulation practice anagrams (EACHP, ALSET, and IKCTS) and 10 post-manipulation test anagrams (e.g., NELMO, ANETLM, ILESM). Instructions directed participants to identify as many solutions as possible for each anagram. The program measured the amount of time that participants spent working on each anagram and recorded their responses.

Participants were run individually by an experimenter blind to hypothesis. After signing a consent form, participants were read the same cover story used in Experiment 1 designed to prevent self-perception effects, and were given the practice anagram set. There was no time limit for this practice exercise. Next, the experimental manipulation was introduced using the same procedures used in Experiment 1, and participants were given the set of 10 test anagrams. Participants were instructed to maintain their assigned arm position, only using the keyboard when they were ready to type a solution, or move on to the next item. Participants were also instructed to resume their previous arm position once they had used the keyboard. As in Experiment 1, the experimenter monitored the degree to which participants correctly followed the arm position instructions, and rated participants' instruction adherence on a 1 (*not at all well*) to 7 (*very well*) scale.

Following the anagram task, participants completed a brief demographics survey and two questions regarding the degree to which they felt *tense* and *relaxed* during the session (1 = *not at all* to 7 = *very much*). These items were included to further address the possibility that greater persistence in the arms crossed condition was due to greater comfort experienced in this condition. Participants also completed a short mood measure (Förster, Higgins, & Strack, 2000), in which they rated the degree to which they experienced the following items while working on the anagrams: *happy*, *content*, *discouraged*, and

[1]One participant's session was interrupted by a person walking into the lab as the experiment was in progress. This participant is not included in the sample of thirty-eight persons.

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disappointed (1 = *not at all true of me* to 7 = *very true of me*). The happy and content items were summed to form a cheerfulness measure ($\alpha = .57$), and the discouraged and disappointed items were summed to form a dejection measure ($\alpha = .90$) measure (Förster et al., 2000). These measures were used to test whether arm crossing led to differences in affective experience and, if so, whether this could account for our findings. For example, arm crossing might facilitate positive mood, thereby enhancing participants' enjoyment of the task and motivating them to persist longer and perform better. Finally, participants received the same funnel debriefing used in Experiment 1 to probe for suspicion and awareness.

Results and Discussion

Preliminary analyses were conducted to test for a main effect of gender. Gender was not significant in any of these analyses, and was not considered further. As in Experiment 1, GPA was utilized as a covariate in all analyses to control for participants' general ability.

Direct Effects

Persistence Simultaneous multiple regression analysis was used to examine the relationship between arm position and persistence, controlling for pre-manipulation persistence ($M = 17.2$, $SD = 9.7$) and general ability ($M = 3.38$, $SD = 0.37$). The experimental contrast compared the arms crossed condition (+1) with the arms-on-thighs control condition (−1). The analysis revealed a significant effect for pre-manipulation persistence, $F(3, 34) = 69.09$, $p < .001$ ($\beta = .82$), indicating that the longer participants persisted on the practice exercise, the longer they persisted on the anagram test. The general ability effect was not significant, $F(3, 34) = 0.24$, $p > .63$. Most importantly, the analysis also revealed an effect of arm position on anagram persistence, $F(3, 34) = 10.80$, $p < .003$ ($\beta = .32$).

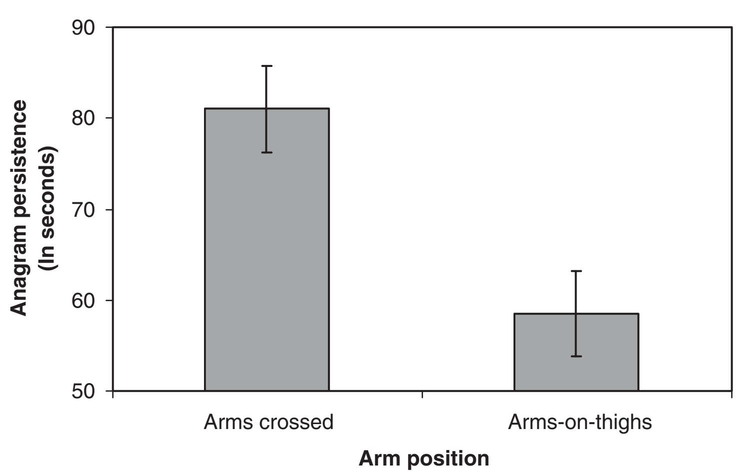

Figure 2. The effect of arm position on anagram persistence in Experiment 2: Mean number of seconds working on solvable anagrams by arm position (means are adjusted for general ability and pre-manipulation persistence). Arms crossed participants persisted for significantly longer ($p < .05$) than arms-on-thighs participants

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Participants in the arms crossed condition continued working on the anagram task longer than did participants in the arms-on-thighs condition (see Figure 2). These results replicate the findings of Experiment 1.

Performance Simultaneous multiple regression analysis was used to examine the relationship between arm position and performance, controlling for pre-manipulation performance ($M = 4.2$, $SD = 1.8$) and general ability. The analysis revealed a significant effect for pre-manipulation performance, $F(3, 34) = 25.16$, $p < .001$ ($\beta = .57$), indicating that participants who performed better on the practice exercise did better on the anagram test. An effect for general ability was also observed, $F(3, 34) = 12.13$, $p < .002$ ($\beta = .39$), indicating that participants with a higher GPA found more correct solutions on the anagram test. Of central importance, the analysis also revealed an effect of arm position on anagram performance, $F(3, 34) = 4.92$, $p < .04$ ($\beta = .24$). Participants in the arms crossed condition found more correct solutions on the anagram test than did those in the arms-on-thighs condition (see Figure 3).

Instruction Adherence, Comfort, Affect, and Funnel Debriefing No difference in instruction adherence was found between the two conditions, $t = -0.17$, $p > .87$. Furthermore, participants in the two conditions reported comparable degrees of tension ($t = 0.56$, $p > .58$) and relaxation ($t = -0.37$, $p > .70$). Likewise, no differences in participants' positive mood ($t = 1.15$, $p > .25$) or negative mood ($t = 0.51$, $p > .62$) were observed between conditions. Independently controlling for the adherence, comfort, and mood variables did not alter the central findings, $Fs(4, 33) \geq 4.12$, $p < .05$, indicating that greater persistence and performance in the arms crossed condition was not due to differences in any of these variables. In addition, in the funnel debriefing, not a single participant expressed suspicion or awareness that the experiment was focused on arm position and persistence/performance.

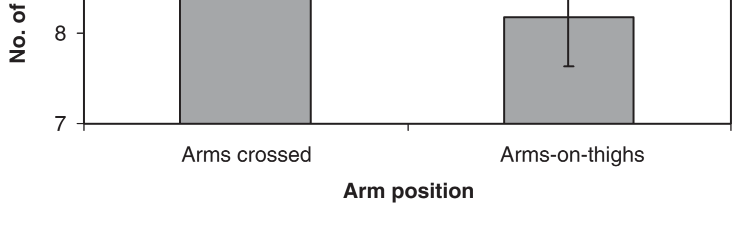

Figure 3. The effect of arm position on anagram performance in Experiment 2: Mean number of correctly solved anagrams by arm position (means are adjusted for general ability and pre-manipulation performance). Arms crossed participants performed significantly better ($p < .05$) than arms-on-thighs participants

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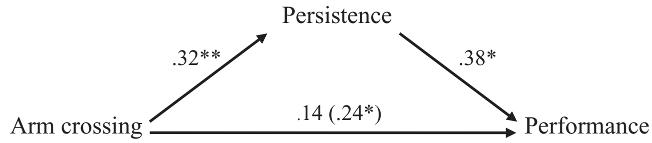

Figure 4. Path coefficients for mediation in Experiment 2. The coefficient in parentheses is from the analysis testing the direct effect of arm crossing on performance. For presentation clarity, only theoretically central variables are included in the diagram. $^{*}\ p \leq .05$, $^{**}\ p < .01$

Mediation Baron and Kenny (1986) outlined three requirements for documenting mediation. First, the dependent variable should be regressed on the independent variable to show that the independent variable predicts the dependent variable. Second, the mediator variable should be regressed on the independent variable to show that the independent variable predicts the mediator variable. Third, the dependent variable should be regressed on both the independent variable and the mediator variable to show that the mediator variable predicts the dependent variable, and accounts for at least a portion of the direct effect of the independent variable on the dependent variable.

In the preceding analyses, the first requirement was satisfied in that arm position predicted performance, and the second requirement was satisfied in that arm position also predicted persistence. To test the final requirement, the regression analysis examining the effect of arm position on performance was repeated, with persistence (as well as pre-manipulation persistence, pre-manipulation performance, and general ability) also included in the equation.

The regression yielded a significant effect for persistence, $F(4,\ 33) = 4.00$, $p \leq .05$ ($\beta = .38$), indicating that the more participants' persisted, the better they performed. The (for the direct effect of arm position on performance was reduced from 0.24 ($p < .04$) to 0.14 ($p > .26$), and Mackinnon, Lockwood, Hoffman, West, and Sheets's (2002) z'-test documented that persistence mediated the effect of arm position on performance, $z' = 1.71$, $p < .01$ (see Figure 4).

GENERAL DISCUSSION

The present research examined the effect of proprioceptive cues on behavior within achievement settings. It was posited that over time, the repeated pairing of arm crossing with perseverance behavior becomes linked in memory, such that the occurrence of one automatically triggers the other. Two experiments supported this hypothesis. Experiment 1 established that arm crossing in an achievement context led to greater persistence on an unsolvable anagram, demonstrating that proprioceptive cues can influence achievement behavior. Experiment 2 replicated this finding, and also revealed that the increased persistence elicited by arm crossing facilitated performance. A mediation analysis confirmed that this performance difference was due to greater persistence in the arms crossed condition. All results were shown to be independent of instruction adherence, comfort, and mood. Furthermore, not a single participant expressed suspicion or guessed the link between arm position and perseverance, suggesting that arm crossing influenced participants' behavior without their awareness.

Our research represents the first demonstration that arm crossing can serve as a proprioceptive cue. Although theorists have proposed that arm crossing is linked to particular psychological states (Bull, 1987; Spiegel & Machotka, 1974), the focus has been on the tendency of psychological states to lead to arm crossing, not on the tendency of arm crossing to produce psychological states. Our research is also one of the first to demonstrate that proprioceptive cues can elicit actual behavior (see also Friedman &

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Förster, 2000). Existing work has extensively documented the influence of proprioceptive cues on affect, attitude, evaluation, and cognitive processing (Cacioppo et al., 1993; Friedman & Förster, 2000; Laird et al., 1982; Neumann & Strack, 2000); our work documents the influence of proprioceptive cues on a specific behavioral tendency.

Importantly, proprioceptive cues may not evoke the same behavioral tendencies in all situations. Our experiments showed that arm crossing elicits perseverance-related behavior in achievement settings, but it may have the opposite influence in interpersonal settings. Arm crossing has been linked to defensiveness in relational contexts (Argyle, 1998; Fast, 1970). If arm crossing operates as a proprioceptive cue in such contexts, it may lead individuals to feel less open to and more distant from relational others during interactions, prompting them to end conversations (and perhaps even relationships) more quickly. Similarly, arm crossing may also possess distinct meanings across different cultures, suggesting that culture may play an important role in determining the influence of proprioceptive cues.

With regard to achievement contexts, our findings highlight the ease with which achievement outcomes may be affected by seemingly inconsequential factors. For example, prior work has identified subtle environmental cues that have an impact on performance attainment. Steele and Aronson (1995) showed that the mere act of reporting ethnicity prior to a test can activate a negative stereotype for African Americans that has a self-fulfilling negative influence on their performance. Elliot, Maier, Moller, Friedman, and Meinhardt (2007) recently demonstrated that a 2-second glimpse of the color red prior to a test can activate avoidance motivation and undermine performance (see also Elliot & Maier, in press). The present research likewise indicates that the mere crossing of one's arms before an achievement task can increase persistence and lead to better performance. Interestingly, the literature on achievement behavior is replete with studies that document how performance can be undermined; our research is unique in identifying a factor that facilitates performance.

The experiments reported herein documented both positive and negative types of persistence effects (see Janoff-Bulman & Brickman, 1982). In Experiment 1, the persistence we examined may be considered counterproductive, because participants poured effort into a task that had no correct solution. In Experiment 2, however, persistence was optimal in that it facilitated performance attainment. Thus, although the influence of proprioceptive cues may be context specific, within a given context, the effect of a cue may be uniform, regardless of the consequences.

Both our theorizing and our empirical findings would seem to fit nicely with Bargh's (1990) auto-motive model of motivation. We posited that arm crossing automatically elicits perseverance-related behavior in achievement contexts, and our funnel debriefing data yielded no evidence that participants were aware of the link between the crossing of their arms and their subsequent persistence (and performance). We concur with Bargh (1990) that an effect such as the one we have documented likely entails the nonconscious activation and operation of a goal, in our case, a perseverance goal. We did not seek to test this possibility in our research, but future research would do well to focus on this issue and, more broadly, on issues pertaining to the motivational mechanisms underlying proprioceptive effects.

Future research may also seek to identify the precise mental constructs activated by arm crossing. Although the present work demonstrated a specific behavioral tendency elicited by arm crossing within achievement settings, the cognitive nature of this response has yet to be fully explored. On one hand, perseverance may represent a behavioral manifestation of a positively focused desire to succeed, or alternatively, it may represent a more negatively focused unwillingness to fail. As such, the specific cognitive underpinnings of arm crossing may shed significant light on its broader psychological effects.

A recent paper (Tamir et al., 2004) raised the intriguing question of whether research on proprioceptive cues implies that people are no more than 'puppets on a string,' unwittingly manipulated by the positions of their bodies. While it may be tempting to agree, it is important to keep in mind two

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points when contemplating the broader implications of this literature. First, in the main, proprioceptive cues serve a highly adaptive function. That is, proprioceptive effects essentially represent shortcuts that allow people to expend minimal resources on navigating the tasks of everyday life, making resources available for other regulatory activities. Second, humans have the capacity to self-regulate—to monitor, reflect on, and strive to adjust their ongoing behavior (Bandura, 1986; Cantor & Kihlstrom, 1986). Any influence on behavior, including subtle influences such as proprioceptive cues, can become the focal point of self-regulation, and with knowledge, effort, and time, intentional adjustments may be made. Thus, it seems that there is little need to lament our vulnerability to nonconscious influences on behavior; rather, it may be more reasonable to laud the efficient, yet flexible operation of the human mind.

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