Title

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Marching Into Battle

Synchronized Walking Diminishes the Conceptualized Formidability of an Antagonist in Men

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Summary

Paralleling behaviors in other species, synchronized movement is central to institutionalized collective human activities thought to enhance cooperation, and experiments demonstrate that synchrony has this effect. The influence of synchrony on cooperation may derive from an evolutionary history wherein such actions served to signal coalitional strength to both participants and observers – including adversaries. If so, then synchronous movement should diminish individuals' estimations of a foe's formidability. Envisioned physical size and strength constitute the dimensions of a representation that summarizes relative fighting capacity. Experiencing synchrony should therefore lead individuals to conceptualize an antagonist as smaller and weaker. We found that men who walked synchronously with a male confederate indeed envisioned a purported criminal as less physically formidable than did men who engaged in this task without synchronizing.

Introduction

McNeill (1) observed that a widespread human practice is the use of synchronous movement to enhance within-group cooperation, particularly in situations of intergroup conflict. Subsequent research reveals that synchronous movement signals alliance affiliation in a variety of cetaceans (2-4), predicting the outcome of agonistic intergroup encounters (4). Likewise, synchronized chorusing is thought to signal alliance affiliation in many primates, and this is demonstrably so in chimpanzees (5). The use of synchrony in humans is thus plausibly understood as the product of a trait that has evolved in a number of species whereby synchronized behavior signals coalitional size, solidarity, and capacity for coordination – a signal of particular importance during intergroup competition (1, 6-9).

Experiments involving orchestrated or spontaneous synchrony in humans demonstrate that synchrony increases cooperation (e.g., 10-15; but see 16), and, conversely, cooperation can spontaneously produce synchrony (17). The effects of synchrony on cooperation in humans are proximately explicable in terms of the recognition of affordances for joint action (10) and the enhancement of feelings of connectedness (reviewed in 18).

Although much literature on synchrony in humans stresses its prosocial consequences, increased bonding and cooperation with ingroup members can produce destructive behaviors directed at outgroups: synchrony increases compliance with requests to aggress against an outgroup (19) or kill insects (20). Elevated aggression is to be expected if the trait at issue evolved in the context of intergroup competition, as, in ancestral populations, much of the adaptive utility of social bonding and cooperation will have derived from collective actions against rival groups. The effects of synchrony should therefore not be limited to affiliative motivation or recognizing affordances for joint action, as other processes relevant to conflict

should be similarly influenced. Here, we explore how synchronous behavior affects representations thought to contribute to decision-making in agonistic contexts.

In agonistic interactions, individuals must rapidly decide whether to fight, flee, or appease. One determinant of this decision is relative fighting capacity. Because many factors contribute to relative fighting capacity, decision-making can be facilitated via a representation that serves as a running tally, summarizing these as each is assessed in turn. We have proposed that, owing to the phylogenetic antiquity and ontogenetic ubiquity of the importance of physical size and strength in agonistic contests, in humans, these dimensions form the basis for such a representation (21). Consonant with this perspective, a foe's envisioned size and muscularity are influenced by his access to weapons (21), propensity to take risks (22), membership in a group stereotyped as dangerous (23), and commitment to conflict (24); the effectiveness of the foe's leaders (25); and the perceiver's strength (26), temporary incapacitation (27), and parenthood status (28). Likewise, inducing changes in perceived social power causes inverse changes in estimates of another's size and weight (29), while feelings of power lead to overestimates of own height and underestimates of another's (30). Notably, the presence of allies reduces estimates of the size and strength of an antagonist (31). If synchrony indexes the potential for cooperation – including joint action in agonistic contexts – then experiencing synchrony should lead individuals to decrease their assessments of an adversary's relative formidability, causing them to envision the foe as smaller and less muscular. We tested this prediction.

Methods

Participants and overview of procedure. See ESM for full methods and discussion of limitations. As men appear particularly sensitive to the possibility of coalitional violence, to

provide the clearest test, we limited our sample to men. Data were pre-screened (see ESM), producing a sample of 96 men (31.3% White; 36.5% Asian; 32.3% Other; age 18-29 [M = 20.02, *SD* = 2.26]).

Participants walked 244 meters along a pathway with a male confederate posing as another participant, then completed a survey packet on site. Participants were randomly assigned to either an experimental condition, in which they were asked to walk in sync with the other person, or a control condition, in which they were instructed to walk at a natural pace.

In the survey, embedded within filler visual estimation tasks, participants estimated the bodily attributes of a supposed criminal based on a cropped "mugshot" of an angry male face. The target's bodily traits were estimated in fixed order: height (to the nearest half-inch), size (assessed using an array of six silhouettes), and muscularity (assessed using an array of six images of male bodies). Estimated physical formidability was composited using standardized values for estimated height, overall size, and muscularity ($\alpha = .58$).[1]

Participants next answered questions about how they felt while walking. The first three items ($\alpha = .65$) pertained to feelings of bonding with the confederate (1 = *Not at all*; 7 = *Very much*). Next, three items measured the perceived difficulty of the walking task, using the same scale ($\alpha = .91$). Participants then rated their feelings toward the confederate using the Inclusion of Other in the Self Scale (IOS; 32), composed of seven pairs of circles, labeled as "self" and "other," ranging from non-overlapping to almost entirely overlapping. Finally, to assess whether any effects of condition owed to changes in affect, participants rated their current states of positive and negative emotion (*happy, joyful, elated,* $\alpha = .87$; *sad, irritated, angry,* $\alpha = .75$).

Results

Effects of condition on bonding, affect, and task difficulty. As predicted, participants in the synchrony condition reported greater feelings of bonding, inclusion of other in the self, and task difficulty, and lower feelings of negative emotion, than did participants in the control condition, *p*s < .03. There was no effect of condition on self-reported positive affect (see Table 1).

Envisioned physical formidability. As predicted, the target individual's envisioned physical formidability was lower in the synchrony condition (M = -.21, SD = .79) than in the control condition (M = .19, SD = .64), $F(1, 94) = 7.48$, $p < .01$, $\eta^2_p = .07$, 95% CI [.11, .69] (see Figure 1). Follow-up tests assessing the individual dimensions of envisioned physical formidability revealed significant differences in estimated height (in inches) and estimated size according to the silhouette array, with a similar trend for estimated muscularity (see Table 2). To assess whether the effect of walking synchronously on the envisioned physical formidability of the criminal was due to indirect effects of bonding, affect, or task difficulty, we ran a simultaneous regression of condition (1 = Control; 2 = Synchrony) and the bonding, inclusion of the other in the self, negative affect, and task difficulty measures, with the target's envisioned physical formidability as the outcome variable. In the model, only synchrony condition predicted the target's envisioned physical formidability (see Table 3; see ESM for additional analyses).

Conclusion

Paralleling conclusions from behavioral observations in cetaceans and apes, consonant with the thesis that a) synchronized movement increases cooperation, and b) cooperative action potentially includes defense against a foe, men who walked synchronously with another man

envisioned a purported criminal as less physically imposing than did men who engaged in the same task without synchronization. Thus, synchrony diminished the perceived relative fighting capacity of the foe.[2]

Although synchrony increased perceived social bonding, this did not mediate the formidability effect, suggesting that these are independent consequences of synchrony. This implies that the diminution of the perceived threat posed by a foe that synchrony induces may not be subjectively experienced as an outgrowth of social bonding. Such experiential independence would be consonant with the utility of cooperation in both agonistic and non-agonistic contexts, and would be consistent with findings that a) absent an agonistic context, synchrony enhances prosociality toward third parties (e.g., 14), and b) ingroup affiliation is independent from hostility towards outgroups (33). Future research should therefore further explore the relationship between bonding and perceived formidability following synchronized movement.

Synchronized behavior can be understood as a multi-directional signal, communicating information to both those who engage in it and observers (including potential adversaries). Changes in assessments of a foe's relative formidability following synchrony can thus be understood as a consequence of the receipt of information concerning affordances for coalitional defense. Correspondingly, observers should assess synchronous groups as more formidable than asynchronous groups – a testable prediction. Lastly, our study employed a threatening target, and thus concerns defensive preparedness. However, if assessments of relative fighting capacity shape behavior in agonistic contexts, then the experience of synchrony may also upregulate the motivation to aggress, as, ceteris paribus, when interests conflict, individuals are more likely to attack if a foe is viewed as less formidable. Given the ubiquity of institutionalized

synchronization in contexts as diverse as athletic competitions and police formations, this disturbing possibility merits investigation.

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Data accessibility

Data archived at http://www.escholarship.org/uc/item/3mc0h2vx.

Notes

[1] Although α of .7 is generally considered necessary to establish reliability, scores of .5 or higher may be acceptable when the measure is comprised of few or notably nonredundant items (34).

[2] It is also possible to measure participants' conceptualizations of themselves (27). However, this requires procedures not suitable to a naturalistic field experiment; such methods may instead prove useful in future laboratory studies of synchrony.

References

1. McNeill WH. *Keeping together in time: Dance and drill in human history*. Harvard University Press; 1995

2. Connor RC, Smolker R, Bejder L. 2006 Synchrony, social behaviour and alliance affiliation in Indian Ocean bottlenose dolphins, *Tursiops aduncus*. *Anim*. *Behav*. **72**, 1371-1378.

3. Senigaglia V, de Stephanis R, Verborgh P, Lusseau D. 2012 The role of synchronized swimming as affiliative and anti-predatory behavior in long-finned pilot whales. *Behav. Processes*. *91*, 8-14.

4. Cusick JA, Herzing DL. 2014 The dynamic of aggression: How individual and group factors affect the long-term interspecific aggression between two sympatric species of dolphin. *Ethology*. **120**, 287-303.

5. Fedurek P, Machanda ZP, Schel AM, Slocombe KE. 2013 Pant hoot chorusing and social bonds in male chimpanzees. *Anim. Behav*. **86**, 189-196.

6. Merker B. 2000 Synchronous chorusing and human origins. In: Wallin NL, Merker B, S B, editors. *The origins of music*. Cambridge, MA: MIT Press. p. 315–327.

7. Huron D. 2001 Is music an evolutionary adaptation? *Ann. New York Acad. Sci*. **930**, 43-61.

8. Hagen EH, Bryant GA. 2003 Music and dance as a coalition signaling system. *Human Nature*. **14**, 21-51.

9. Fitch W. 2006 The biology and evolution of music: A comparative perspective. *Cognition*. **100**, 173-215.

10. Marsh KL, Richardson MJ, Schmidt RC. 2009 Social connection through joint action and interpersonal coordination. *Topics Cog. Sci*. **1**, 320-339.

11. Wiltermuth SS, Heath C. 2009 Synchrony and cooperation. *Psychol. Sci*. **20**, 1-5.

12. Kirschner S, Tomasello M. 2010 Joint music making promotes prosocial behavior in 4-year-old children. *Evol. Hum. Behav*. **31**, 354-364.

13. Fischer R, Callander R, Reddish P, Bulbulia J. 2013 How do rituals affect cooperation? An experimental field study comparing nine ritual types. *Human Nature*. **24**, 115-125.

14. Reddish P, Bulbulia J, Fischer R. 2013 Does synchrony promote generalized prosociality? *Relig., Brain & Behav*. **4**, 3-19.

15. Reddish P, Fischer R, Bulbulia J. 2013 Let's dance together: Synchrony, shared intentionality and cooperation. *PLoS ONE*. **8**, e71182.

16. Kirschner S, Ilari B. 2014 Joint drumming in Brazilian and German preschool children: Cultural differences in rhythmic entrainment, but no prosocial effects. *J. Cross-Cult. Psych*. **45**, 137-166.

17. Strang AJ, Funke GJ, Russell SM, Dukes AW, Middendorf MS. 2014 Physio-behavioral coupling in a cooperative team task: Contributors and relations. *J. Expt. Psych*. **40**, 145-158.

18. Miles LK, Nind LK, Macrae CN. 2009 The rhythm of rapport: Interpersonal synchrony and social perception. *J. Expt. Social Psych*. **45**, 585-589.

19. Wiltermuth SS. 2012 Synchronous activity boosts compliance with requests to aggress. *J. Expt. Social Psych*. **48**, 453-456.

20. Wiltermuth S. 2012 Synchrony and destructive obedience. *Social Influence*. **7**, 78-89.

21. Fessler DMT, Holbrook C, Snyder JK. 2012 Weapons make the man (larger): Formidability is represented as size and strength in humans. *PloS ONE*. **7**, e32751.

22. Fessler DMT, Tiokhin L, Holbrook C, Gervais M, Snyder JK. 2014 Foundations of the Crazy Bastard Hypothesis: Nonviolent physical risk-taking enhances conceptualized formidability. *Evol. Hum. Behav.* **35**, 26-33.

23. Holbrook C, Fessler DMT, Navarrete CD. n.d. Stature or danger: Racist stereotypes moderate the conceptual links between threat, social status, and physical size. Manuscript under review.

24. Fessler DMT, Holbrook C, Dashoff D. n.d. Dressed to kill? Visible markers of coalitional affiliation enhance conceptualized formidability. Manuscript under review.

25. Holbrook C, Fessler DMT. 2013 Sizing up the threat: The envisioned physical formidability of terrorists tracks their leaders' failures and successes. *Cognition*. **127**, 46-56.

26. Fessler DMT, Holbrook C, Gervais M. in press Men's physical strength moderates conceptualizations of prospective foes in two disparate societies. *Human Nature*.

27. Fessler DMT, Holbrook C. 2013 Bound to lose: Physical incapacitation increases the conceptualized dimensions of an antagonist in men. *PLoS ONE*. **8**, e71306.

28. Fessler DMT, Holbrook C, Pollack JS, Hahn-Holbrook J. 2014 Stranger danger: Parenthood increases the envisioned bodily formidability of menacing men. *Evol. Hum. Behav.* **35**,109-117.

29. Yap AJ, Mason MF, Ames DR. 2013 The powerful size others down: The link between power and estimates of others' size. *J. Expt. Social Psych.* **49**, 591-594.

30. Duguid MM, Goncalo JA. 2012 Living large: The powerful overestimate their own height. *Psychol. Sci.* **23**, 36-40.

31. Fessler DMT, Holbrook C. 2013 Friends shrink foes: The presence of comrades decreases the envisioned physical formidability of an opponent. *Psychol. Sci.* **24**, 797-802.

32. Aron A, Aron EN, Smollan D. 1992 Inclusion of Other in the Self Scale and the structure of interpersonal closeness. *J. Person. Social Psych.* **63**, 596-612.

33. Brewer MB. 1999 The psychology of prejudice: Ingroup love and outgroup hate? *J. Social Issues.* **55**, 429-444.

34. Robinson JP, Wrightsman LS, Andrews FM, editors. 1991 Measures of personality and social psychological attitudes. San Diego: Academic Press.

Table 1

Mean Rated Bonding, Inclusion of Other in the Self, Positive Affect, Negative Affect, and Task Difficulty

	Control	Synchronous				
	Mean (SD)	*Mean (SD)*	*F*	*p*	η^2_p	95% CI
Bonding	3.15 (1.01)	3.90 (1.17)	11.50	.001	.11	-1.19, -.31
IOS	1.82 (.82)	2.53 (1.18)	11.97	.001	.11	-1.12, -.30
Positive affect	3.67 (1.19)	3.95 (1.44)	1.05	.307	.01	-.81, .26
Negative affect	1.98 (1.20)	1.53 (.61)	5.26	.024	.05	.06, .85
Task difficulty	1.82 (1.23)	2.86 (1.53)	13.72	<.001	.13	-1.60, -.48

Table 2

Mean Estimated Height, Size, and Muscularity of Target

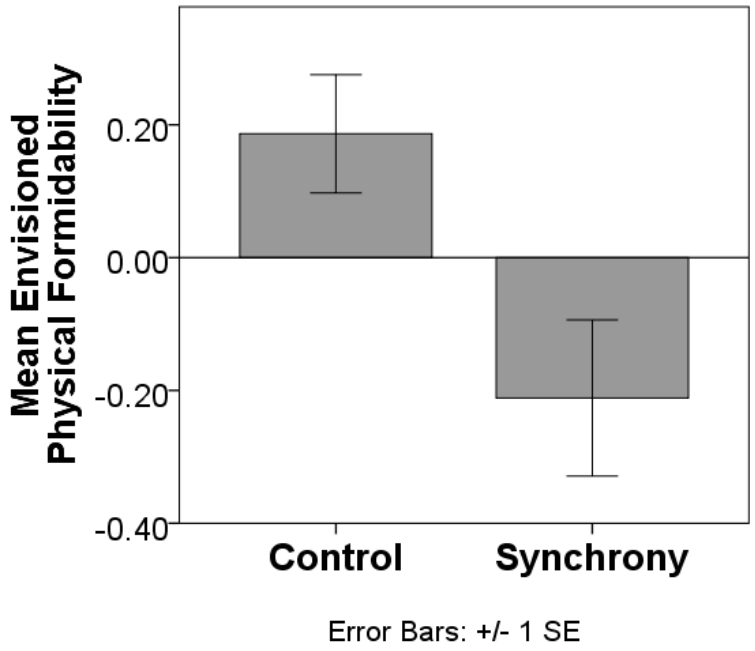
	Control	Synchronous				
	Mean (SD)	*Mean (SD)*	*F*	*p*	η^2_p	95% CI
Height (in.)	69.66 (1.96)	68.71 (2.39)	4.52	.036	.05	.06, 1.83
Size	3.82 (.84)	3.44 (1.01)	4.01	.048	.04	.003, .76
Muscularity	2.75 (.82)	2.44 (.81)	3.24	.075	.03	-.03, .63

Table 3

Linear Regression of Potential Predictors of Target's Estimated Physical Formidability

	B	*p*
Condition	-.299	.015
Bonding	.139	.253
IOS	-.069	.566
Negative affect	-.072	.493
Task difficulty	-.034	.758

Figure 1. Estimations of target's physical formidability (standardized scores) by condition.



Electronic Supplementary Material

to accompany

Marching Into Battle: Synchronized Walking Diminishes the Conceptualized Formidability of an Antagonist in Humans

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Methods

A target sample size of 100 was selected in advance of data collection based on prior work on synchrony and aggression (1,2). Anticipating some loss due to noncompliance and similar problems, data collection was therefore stopped at 110.

Male undergraduate students at the University of California, Los Angeles were recruited by female research assistants in a public area on the university campus for a field study, advertised as a survey of "Motor Exertion, Feelings, and Visual Intuition," in exchange for $3 compensation. The study was framed as investigating links between physical activity, emotion, and visual perception.

Data were pre-screened to ensure response completeness, English fluency, correct answers to a "catch question" asking how many letters are in the English alphabet, and the absence of unexpected disruptions (e.g., an ambulance driving through the study area). Data from fourteen participants were removed on the above grounds prior to analysis.

In a between-subjects design, participants were asked to walk 244 meters along a paved public pathway on the UCLA campus that had been cordoned off by the researchers to prevent passers-by from interacting directly with the participants. A male research confederate posed as another

participant; participants were asked to walk the length of the cordoned-off section of pathway, then return to the starting point to complete a survey packet at that public, outdoor location. Participants were randomly assigned to either an experimental condition or a control condition. In the experimental condition, the participant and the confederate were asked to walk in sync with one another, starting on the left foot; in the control condition, the participant was instructed to "walk at your own natural pace—there is no need to try to keep up with one another." Immediately upon returning to the starting point, the participant and the confederate were each given identical copies of the survey (reproduced in its entirety in this ESM), and were asked to stand at locations approximately 4 meters apart from one another while completing the survey.

The key stimulus in the survey packet is an image of an angry man's face (pages 14-16 of this ESM); both this image and the filler task image of a woman's face (page 13 of this ESM) are taken from the Radboud Faces Database (3), and are approved for public display and publication.

The core dependent measures embedded in the survey packet consist of 1) a question asking the participant to provide a numerical estimate the target individual's height (page 14 of this ESM); 2) a question asking the participant to select the envisioned body size of the target individual from an array of otherwise identical male silhouettes varying only in size (page 15 of this ESM); and 3) a question asking the participant to select the envisioned body type of the target individual from an array a matrix of computer-generated images of male bodies differing in degree of muscularity (page 16 of this ESM). The latter array was modified with permission from (4).

Effects of Ethnicity

The final sample was composed of 35 Asian participants, 30 White participants, and 31 participants who identified as of "mixed or other" ethnicity. Despite randomly assigning participants to condition, follow-up checks revealed that a disproportionate percentage of Asian men (N = 21) were inadvertently assigned to the synchrony condition relative to White men (N = 8). Conversely, fewer Asian men (N = 14) were also assigned to the control condition than were White men (N = 22). Accordingly, we tested whether ethnicity might influence the estimated physical formidability of the target individual, or other variables that might indirectly influence envisioned formidability (social bonding, state positive affect, or state negative affect). There were no significant effects of ethnicity, or interactions between condition and ethnicity, for the measures of state affect or estimated physical formidability. However, Asian men were significantly higher than participants from either of the other ethnic categories in social bonding (see Supplementary Table 1). This pattern raises the possibility that the disproportionate assignment of Asians to the synchrony condition may have indirectly decreased the envisioned formidability of the prospective antagonist due to the relatively higher level of social bonding. Therefore, to ensure that it was the synchrony manipulation, rather than participant ethnicity, that caused the shift in physical formidability estimates, we conducted an ANCOVA controlling for ethnicity. As predicted, the target individual's envisioned physical formidability remained significantly lower in the synchrony condition than in the control condition, $F(1, 93) = 7.17$, $p < .01$, $\eta^2_p = .07$, 95% CI [.10, .68]. Follow-up tests, controlling for ethnicity, assessing the individual dimensions of envisioned physical formidability, revealed significant differences in estimated height, $p < .05$, and, in a nonsignificant trend, estimated size, $p < .06$. As in the original analysis, the muscularity of the prospective antagonist was not significantly lower in the synchrony condition, although there was a trend in the predicted direction, $p < .08$. Finally, to assess whether the disproportionate number of Asian men in the synchrony condition accounted for the observed increase in social bonding, we

conducted an ANCOVA controlling for participant ethnicity. The ANCOVA revealed that, controlling for ethnicity, the effect of condition on social bonding remained significant, $F(1, 93) = 10.77$, $p < .01$, $\eta^2_p = .10$, 95% CI [-1.13, -.28]. In summary, the unequal distribution of Asian and White men between the two conditions does not appear to provide an alternative explanation for the observed effects of the manipulation on either estimated physical formidability or social bonding.

Supplementary Table 1. Effects of participant ethnicity on state affect, social bonding, and estimated physical formidability

	Asian (N = 35)		White (N = 30)		Other (N = 31)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
Positive Affect	3.90[a]	1.51	3.80[a]	1.27	3.70[a]	1.12	.08	>.92
Negative Affect	1.73[a]	.77	1.86[a]	1.20	1.72[a]	1.02	.01	>.99
Social Bonding	4.01[a]	1.22	3.20[b]	.84	3.23[b]	1.14	4.52	<.01
Formidability	-.08[a]	.80	.05[a]	.63	.04[a]	.77	.16	>.85

Note. Estimated physical formidability scores are standardized (z-scores). Means with different superscripts are significantly different with alpha at .05. *F* and *p* values refer to main effects of participant ethnicity.

To further rule out the potentially confounding effect of having had more Asian men assigned to the synchrony condition, we next re-analyzed data from comparable previous investigations of

envisioned formidability. Recently, we conducted a within-subjects study on the UCLA campus in which participants rated two targets, one of whom was predicted to be envisioned as more formidable because he had entered a conflictual social arena while displaying a signal of coalitional affiliation, thereby objectively committing himself to the fray (5, Study 1). We re-analyzed this dataset using only the subsample of White (*N* = 45) and Asian (*N* = 18) male participants. Whereas, as predicted, the manipulation that we employed heightened the estimated formidability of the experimental target relative to the control target, there was no significant effects of ethnicity on judgments of either targets' height, size, or muscularity, *p*s .19 - .80. In another within-subjects study conducted on the UCLA campus, men estimated the physical formidability of angry-faced male targets while either physically restrained to a chair or while sitting unrestrained (6). We re-analyzed this data comparing only the White (*N* = 19) versus Asian (*N* = 12) subsample, again finding the predicted effect of condition, but no significant effects of ethnicity on judgments of either targets' height, size, or muscularity, *p*s .19 - .94. Taken together, the above considerations indicate that the ethnic imbalance across conditions that occurred in the present study does not undermine our core finding that synchronized behavior reduces the envisioned physical formidability of a foe.

Limitations and Additional Analyses

Having verbally instructed participants as to how to walk, the researcher was not blind to condition, and was aware of the hypothesis at issue. We therefore cannot rule out the possibility that the researcher might have inadvertently influenced participants in such a way as to produce the predicted effects. Importantly, however, the opportunities for such influence were extremely limited, as, upon completing the walking task, participants were simply handed a clipboard and asked to complete the written questionnaire that contained the dependent measures – no further interaction

took place between the researcher and the participant. In light of this, while experimenter effects are possible, we think them unlikely.

The confederate too was aware of the hypothesis, and, by virtue of his posing as another participant, he was given the same instructions as the participant, at the same time as the participant, and thus he was not blind to condition (even absent this step, the condition to which a given participant had been assigned would have been obvious to the confederate, as they walked side by side). Prior to data collection, the confederate was briefed on the importance of maintaining a neutral demeanor throughout, and refraining from speaking to or otherwise interacting with the participant. However, such safeguards are imperfect, hence it is possible that the confederate unintentionally acted in ways that could have influenced the participant above and beyond any effects of the experience of synchrony. While we cannot rule this possibility out, it seems unlikely to explain our findings given that the most probable avenue for such influence would be through nonverbal cues of affiliation or the lack thereof, yet the diminished estimates of the foe's bodily formidability provided by participants in the synchrony condition were not mediated by the increased social bonding that they reported relative to participants in the control condition. Nonetheless, future investigations of this topic would be strengthened by designs in which the confederate is blind to condition.

Although informal observation suggests that assignment to condition had a strong effect on behavior during the walking task, we did not measure the degree to which synchrony actually occurred. Accordingly, it is possible that the observed effect of condition on estimates of the foe's formidability was not a consequence of the experience of synchrony per se, but rather stemmed from the experience of attempting to engage in a modestly challenging task involving another party – a category that subsumes, but is vastly larger than, synchronous behavior. While we cannot eliminate this possibility, we think it unlikely given that perceived task difficulty – which was low in both conditions, but

nonetheless differed significantly by condition (see Table 1) – does not mediate the effect of condition on the envisioned formidability of the foe. In the paper, we report results of a regression model that included condition and the bonding, inclusion of the other in the self, negative affect, and task difficulty measures, along with the composite measure of the foe's bodily formidability; in this model, only condition predicted the key dependent measure (see Table 3). Nevertheless, although task difficulty did not significantly correlate with envisioned physical formidability in this model, it is possible that the effect of condition (and/or other predictors in the model) obscured an otherwise observable relationship in this regard. We therefore conducted follow-up tests to ascertain whether task difficulty influenced assessments of the criminal target's physical formidability.

Pooling conditions, we found no significant correlation between task difficulty and the target's envisioned physical formidability, $r(96) = -.14$, $p = .17$, nor was there any significant correlation between these two variables within the control condition, $r(51) = .10$, $p = .47$, nor within the synchrony condition, $r(45) = -.17$, $p = .28$, when analyzed separately. To further confirm that the synchrony condition did not moderate the relationship between task difficulty and envisioned physical formidability, we entered task difficulty (centered), condition (Control = 1; Synchrony = 2), and the interaction between task difficulty and condition into a simultaneous regression, with physical formidability as the outcome variable. The overall regression was statistically significant, $R = .304$, $R^2 = .092$, adjusted $R^2 = .063$, $F(3, 92) = 3.13$, $p = .03$. The model revealed no significant interaction between condition and task difficulty, $b = -.14$, $SE = .11$, $\beta = -.45$, $p = .20$). In the model, there was also a significant effect of condition, $b = -.38$, $SE = .16$, $\beta = -.26$, $p < .02$, but no effect of task difficulty, $b = .19$, $SE = .18$, $\beta = .38$, $p = .28$. In sum, we found no indication that task difficulty influenced the envisioned physical formidability of the target.

Parallel tests were also conducted to assess whether bonding with the confederate, Inclusion of Other in the Self (IOS), or negative affect (all of which were significantly affected by synchronous

walking) influenced the envisioned physical formidability of the target. As in the case of task difficulty, there were no observed correlations between any of these variables and envisioned physical formidability in the entire sample, *rs* -.09 - .01, *p*s > .36, within the control condition, *rs* -.13 - .13, *p*s > .35, or within the synchrony condition, *rs* -.08 - .08, *p*s > .59. Thus, there were no significant relationships between the envisioned physical formidability of the target and bonding, IOS, or negative affect.

Because we did not measure the extent to which synchrony occurred, it is possible that, in addition to the implications of task difficulty discussed above, there is an effect of merely thinking about synchrony. The fact that participants in the synchrony condition reported greater task difficulty suggests that, not surprisingly, they were highly cognizant of this goal. Mental simulations often have similar affective and cognitive consequences relative to lived experience (7,8). As a result, it is possible that some portion of the influence of experimental condition in our study stemmed not from engaging in synchronous behavior with another party, but rather from simply envisioning such an experience. Although our present findings do not allow us to tease out such effects, this could be accomplished by adding a third condition to our experimental design, one in which participants merely contemplated engaging in synchronous walking with the confederate. Lastly, future investigations of this topic should also include objective measures of synchrony, as this will both allow for more direct causal inferences and facilitate comparisons between studies of synchrony in humans and parallel investigations in nonhuman species.

References

1. Wiltermuth SS. 2012 Synchronous activity boosts compliance with requests to aggress. *J. Expt. Social Psych*. **48**, 453-456.

2. Wiltermuth S. 2012 Synchrony and destructive obedience. *Social Influence*. **7**, 78-89.

3. Langner O, Dotsch R, Bijlstra G, Wigboldus DHJ, Hawk ST, van Knippenberg A. 2010 Presentation and validation of the Radboud Faces Database. *Cog. Emot.* **24**, 1377-1388.

4. Frederick, D. A., & Peplau, L. A. 2007. *The UCLA Body Matrices II: Computer-generated images of men and women varying in body fat and muscularity/breast size to assess body satisfaction and preferences*. Proceedings from 8th Annual Meeting of the Society for Personality and Social Psychology, Memphis, TN.

5. Fessler, D. M. T., Holbrook, C., & Dashoff, D. Under review. Dressed to kill? Visible markers of coalitional affiliation enhance conceptualized formidability.

6. Fessler D. M. T., & Holbrook C. 2013 Bound to lose: Physical incapacitation increases the conceptualized dimensions of an antagonist in men. *PLoS ONE*. 8, e71306.

7. Taylor, S. E., Pham, L. B., Rivkin, I. D. & Armor, D. A. 1998 Harnessing the imagination: Mental simulation, self-regulation, and coping. *American Psychologist.* **53**, 429.

8. Lafleur, M. F., Jackson, P. L., Malouin, F., Richards, C. L., Evans, A. C., & Doyon, J. 2002 Motor learning produces parallel dynamic functional changes during the execution and imagination of sequential foot movements. *Neuroimage*. **16**, 142-157.

Complete Survey Packet

INSTRUCTIONS :

This packet contains a variety of tasks that explore the links between motor exertion, visual perception and visual intuition. Please answer the questions as best you can, without overthinking things or stopping to ask the research assistant for guidance. If in doubt, please just use your best guess or hunch.

Thanks again for your assistance!

This image is grey—

how many colors of jelly beans would you estimate were in the original picture?

# of colors: _____

In your estimation, what is the oldest that this woman could be?

Age (in years): _____

This cropped image was taken from a criminal mugshot.

Please attempt to estimate this man's bodily characteristics.

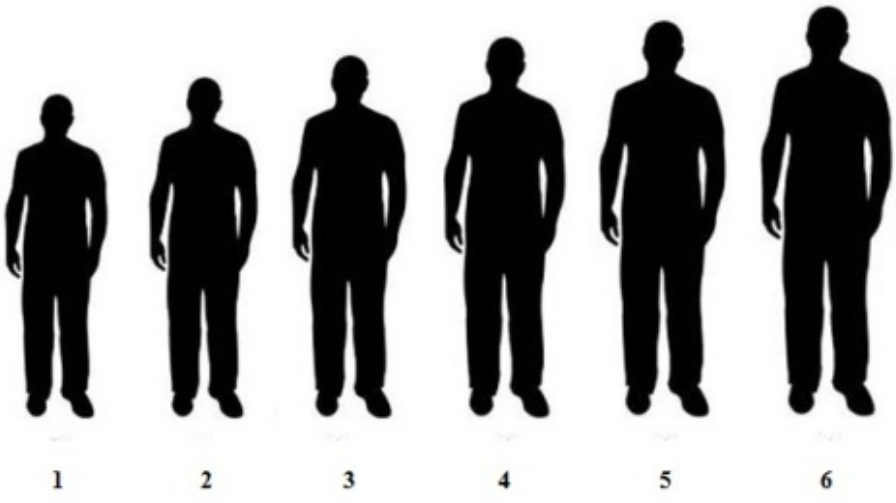
Answer the questions which follow using your best guess or intuition.

What would you estimate this man's height to be, to the nearest half-inch?

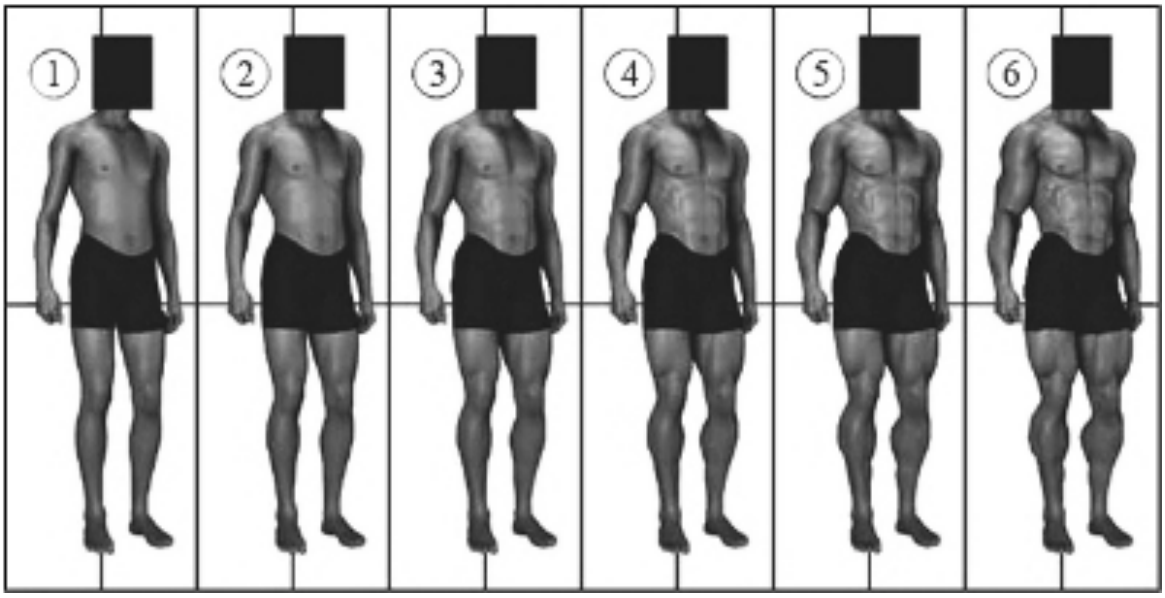
Feet : _____ **Inches** : _____

(If you are more familiar with the metric system, please estimate his height in meters: _____)

Circle the number of the image that best matches how you picture the man in the photo:



Circle the number of the image that best matches the strength of the man in the photo:



Please answer the following questions based on how you felt <u>during the walking task</u>.

- How connected did you feel to the other participant?

o o o o o o o

Not at all Very much

- How much did you like the other participant?

o o o o o o o

Not at all Very much

- How similar did you feel to the other participant?

o o o o o o o

Not at all Very much

- How difficult was it to walk with the other person as you were instructed?

o o o o o o o

Not at all Very much

- How demanding was it to walk with the other person as you were instructed?

o o o o o o o

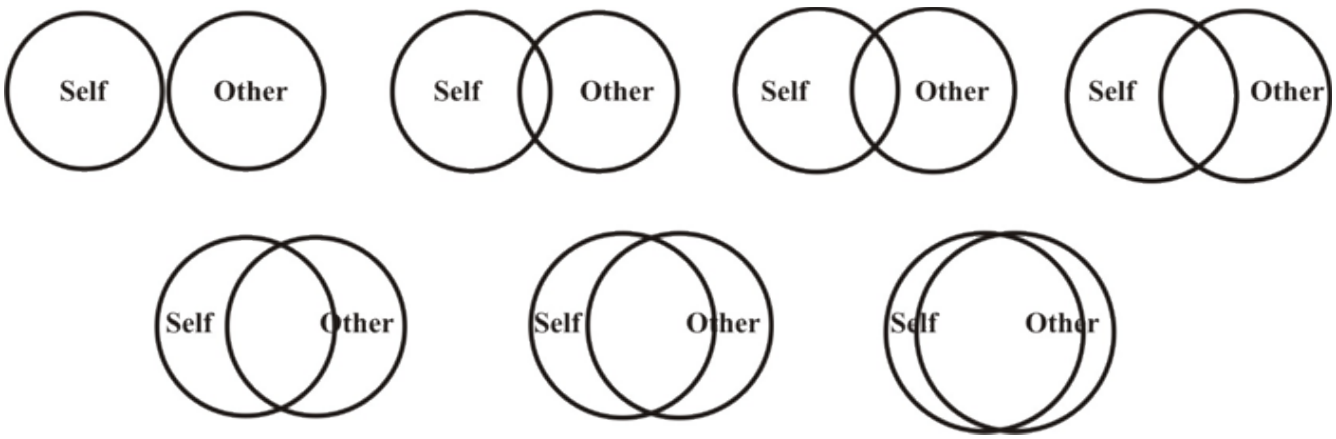
Not at all Very much

- How much effort did it take to walk with the other person as you were instructed?

o o o o o o o

Not at all Very much

Please circle the picture that best describes how you feel toward the other participant in today's study:



Please rate how much you feel the following feelings or emotions, **right now** :

1. Sad o o o o o o o

Not at all Very much

---

2. Happy o o o o o o o

Not at all Very much

---

3. Irritated o o o o o o o

Not at all Very much

---

4. Joyful o o o o o o o

Not at all Very much

---

5. Angry o o o o o o o

Not at all Very much

---

6. Elated o o o o o o o

Not at all Very much

Demographics

- Age: _____
- Ethnicity: _____

- Your height: *Feet* ____ *Inches* ____
- Your weight (in pounds) : _____

- In your daily life, do you usually use the Metric system or the English system of measurement?
    - Metric
    - English

- How many letters are in the English alphabet? _____

- What is your sex?
    - Female
    - Male

- Is English your first language?

- Yes
- No

- To what extent did you walk “in-step” with the other participant?

o o o o o o o o o

Not at all 100%

in synch