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Report

The Social Dominance Paradox

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Summary

Dominant individuals report high levels of self-sufficiency, self-esteem, and authoritarianism. The lay stereotype suggests that such individuals ignore information from others, preferring to make their own choices. However, the nonhuman animal literature presents a conflicting view, suggesting that dominant individuals are avid social learners, whereas subordinates focus on learning from private experience. Whether dominant humans are best characterized by the lay stereotype or the animal view is currently unknown. Here, we present a "social dominance paradox": using self-report scales and computerized tasks, we demonstrate that socially dominant people explicitly value independence, but, paradoxically, in a complex decision-making task, they show an enhanced reliance (relative to subordinate individuals) on social learning. More specifically, socially dominant people employed a strategy of copying other agents when the agents' responses had a history of being correct. However, in humans, two subtypes of dominance have been identified [1]: aggressive and social. Aggressively dominant individuals, who are as likely to "get their own way" as socially dominant individuals but who do so through the use of aggressive or Machiavellian tactics, did not use social information, even when it was beneficial to do so. This paper presents the first study of dominance and social learning in humans and challenges the lay stereotype in which all dominant individuals ignore others' views [2]. The more subtle perspective we offer could have important implications for decision making in both the boardroom and the classroom.

Results and Discussion

In experiment 1, adult participants (n = 33; age mean = 27.88, SEM = 1.39; 19 males, 14 females; Table S1 available online) completed subjective rating scales of social dominance (SD) and aggressive dominance (AD) [1, 3] (see Supp. Exp. Proc. 1 in Supplemental Experimental Procedures) and a computerized decision-making task [4] that enabled separate investigation of individual and social learning [4] (Figure 1). Validation studies [1] have demonstrated that individuals who score high in either SD or AD, on the scales we employed, have strong beliefs about the importance of individual accountability and self-report high levels of self-esteem, authoritarianism, and self-sufficiency [1]. In a real-life social interaction, wherein participants work in groups to select a hypothetical new housemate, high SD and AD individuals excel in influencing the group's choice according to their personal preferences. However, analysis of video recordings of such interactions demonstrates significant differences in the methods employed: whereas SDs tend to rely on reasoning to persuade others, ADs use aggression and Machiavellian tactics such as threat, deceit, and flattery [1].

In the decision-making task, participants scored points by using individually experienced (outcome history) and/or social (Figure 1, red frame) information to make choices between a blue and a green stimulus. In each trial, a red frame surrounded one of the two stimuli. Participants were instructed that this frame (the social information) represented the most popular choice made by a group of four participants who had completed the task previously. The actual probability of reward associated with the blue and green boxes and the probability that the red frame surrounded the correct box varied according to uncorrelated pseudorandom schedules (Figure 2; Supp. Exp. Proc. 2 in Supplemental Experimental Procedures). A Bayesian learner model algorithm [4, 5] was employed to create two models of optimal performance (Figure 2): the individual learner model and the social learner model. The individual learner model comprised the probability, based on the outcome history, that a blue choice would be rewarded. Thus, for each trial, its value represented the reward probability associated with a blue choice that a participant would have derived if they had been learning, in an optimal fashion, exclusively from private information about reward outcomes (i.e., ignoring the social information). The social learner model comprised the probability, based on the social information weighted by the history of correct social information, that the group's choice would be rewarded. From this model, we computed, for each trial, the reward probability of a blue choice that a participant would have derived if they had been learning, in an optimal fashion, exclusively from the social information (i.e., ignoring individual experience). Using logistic regression, we regressed these two models against participants' choices. This resulted in individual and social beta values (regression slopes) that represent the degree to which choices were explained by the two respective models. A participant whose choices were strongly influenced by the social information (reflected in the social learner model) would have a high social beta value, and a participant who consistently went against the social information would have a negative social beta value.

Multiple regression models applied at the group level showed that SD ($t(32) = 2.08$, $p = 0.048$, standardized β [stdβ] = 0.39) was a significant positive predictor of the social beta values: the higher a participant scored in SD, the more they used the social information, as estimated by the social learner model, to make their choices (Figure 3; Figure S1; see Supp. Exp. Proc. 3 in Supplemental Experimental Procedures for replication study). In contrast, AD was a significant negative predictor of social betas ($t(32) = -2.74$, $p = 0.01$, std$\beta = -0.49$): the higher a participant scored in AD, the less likely they were to use the social information to make their choices. Notably, there was no correlation between SD and AD ($r = 0.21$, $p = 0.24$). Fisher's r-to-z transformation (Table S2) confirmed that the relationship between SD and the use of social information was significantly different from the relationship between AD and the use of social information ($z = 3.57$, $p = 0.0002$). By regressing dominance scores against mean number of correct responses, we also found that aggressive ($t(32) = -2.27$, $p = 0.03$, std$\beta = -0.41$), but not social ($t(32) = -0.11$, $p = 0.91$, std$\beta = -0.02$), dominance was

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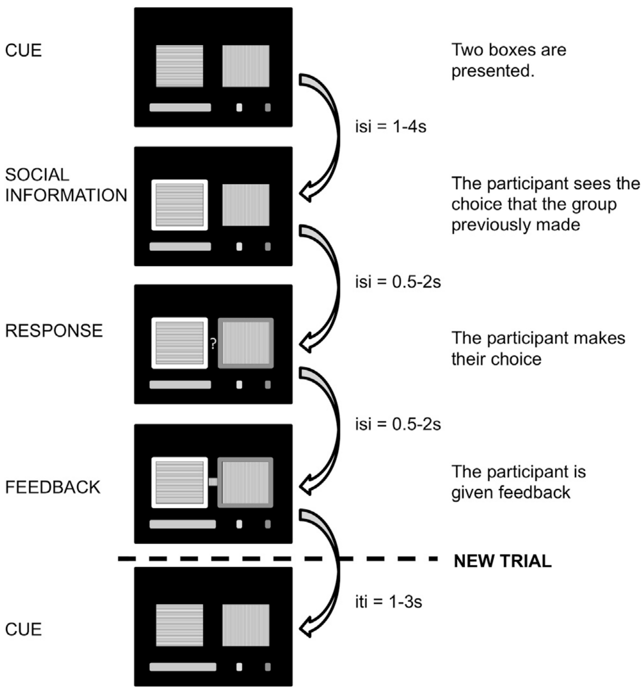

Figure 1. Task Flow Diagram

In the decision task, participants were required to select between a blue and green box in order to win points. In each trial, participants first saw a cue screen for between 1 s and 4 s. Then, either the blue or the green box was highlighted with a red frame. Participants were instructed that this frame represented either the most popular choice made by a group of four participants who had completed the task previously (experiment 1) or the choice from a computer-simulated roulette wheel (experiment 2). After 0.5–2 s, a question mark appeared, indicating that the participant could make their response. Immediately after participants had responded, their selected option was framed in gray. A further 0.5–2 s interval ensued, after which participants received feedback in the form of a green or blue box in the middle of the screen. If participants were successful, the red reward bar progressed toward the silver and gold goals. The probability of reward associated with the blue and green boxes and the probability that the red frame surrounded the correct box varied according to uncorrelated pseudorandom schedules (Figure 2; Supp. Exp. Proc. 2 in Supplemental Experimental Procedures). Note that in the above figure, red, blue, and green have been replaced with white, gray stripes, and gray checks. ISI, interstimulus interval; ITI, intertrial interval.

predictive of poor overall performance. Neither social ($t(32) = -0.45$, $p = 0.66$, std$\beta = -0.11$) nor aggressive ($t(32) = 0.71$, $p = 0.49$, std$\beta = 0.16$) dominance predicted individual learning betas, and both SD and AD were significantly better predictors of social learning than of individual learning (SD: Fisher's r-to-z = 1.9, $p = 0.03$; AD: Fisher's r-to-z = −2.57, $p = 0.01$). Together, these results suggest that whereas responses from socially dominant individuals followed those of the group, responses from aggressively dominant individuals did not. This neglect of social information had a detrimental effect on the AD individuals' overall task performance.

The link between SD and social learning concurs with findings concerning other social animals (e.g., bird and primate species) in which dominant individuals tend to be social learners, whereas subordinates tend to rely on individual learning [6, 7]. Modeling in economics and behavioral ecology has shown that whereas individual learning can be slow, risky, and costly in energetic terms, these pitfalls can be avoided by social learning. However, if all group members learn only socially, the group's wisdom can diverge from reality [7, 8]. Thus, a division of labor, in which highly socially dominant individuals favor social learning and subordinate individuals are dedicated individual learners, may serve to optimize knowledge acquisition at the group level.

In the current task, there are a number of ways that the social information can be used to one's advantage: (1) one could identify when the information is predominantly correct and copy the group's responses (matching), (2) one could identify when the information is predominantly incorrect and select the nonrecommended option (nonmatching), or (3) optimally, one could use both of these strategies. Notably, matching and nonmatching are equal in utility, but only nonmatching involves actively going against the group's choice. To investigate which strategy was driving the effect of SD, we conducted a further analysis that separated trials in which the social information was predominantly correct (p [red frame = correct] > 0.5, with probabilities derived from the social learner model) from those in which it was predominantly incorrect (p [red frame = correct] < 0.5). This analysis showed that SD was a significant predictor of the use of predominantly correct ($t(32) = 2.86$, $p = 0.01$, std$\beta = 0.56$, partial $r = 0.50$), but not predominantly incorrect ($t(32) = 0.25$, $p = 0.81$, std$\beta = 0.05$, partial $r = 0.05$), social information (see Supp. Exp. Proc. 4a in Supplemental Experimental Procedures for replication study). SD was a better predictor of the use of predominantly correct than incorrect information (Fisher's r-to-z = 1.93, $p = 0.05$; see Supp. Exp. Proc. 4b in Supplemental Experimental Procedures for AD analysis). These results indicate that the superior performance of SD individuals was based primarily on their tendency to match, rather than to nonmatch, social information—to copy other agents when the other agents' responses were correct, rather than to choose the alternative when the agents' responses were incorrect. Given that matching and nonmatching would have been equally effective in scoring points and that copying is known to promote cooperative behavior [9], this suggests that SDs may use social learning to serve not only instrumental and epistemic functions but also interpersonal functions, such as the promotion of positive social attitudes between informant and learner.

In nonhuman primates, subordination has been associated with suboptimal dopamine system function [10, 11]. Given that dopamine has been linked to general learning processes, as opposed to specifically social learning processes [12–14], this raises an important question for our study: does the effect of dominance generalize to learning from any indirect source of information? To find out, we ran a second experiment in which the procedure and data analysis were identical, but participants were told that the red frame represented the "choice" of a computer program simulating roulette wheels rather than choices made by other agents. Participants were informed that the roulette wheels could fluctuate between selecting predominantly correct and predominantly incorrect choices (Supp. Exp. Proc. 2 and Supp. Exp. Proc. 5 in Supplemental Experimental Procedures). In this group ($n = 34$; age mean = 26.21, SEM = 0.96; 19 males, 15 females; Table S1), the effect of the red frame was unrelated to social ($t(33) = 0.42$, $p = 0.68$, std$\beta = 0.09$) or aggressive ($t(33) = -0.78$, $p = 0.94$, std$\beta = -0.01$) dominance (see Supp. Exp. Proc. 6 in Supplemental Experimental Procedures for further analysis). These data suggest that the effects of indirect information on choice in experiment 1 depended on the participants believing that the red frame represented the behavior of other agents, i.e., social information.

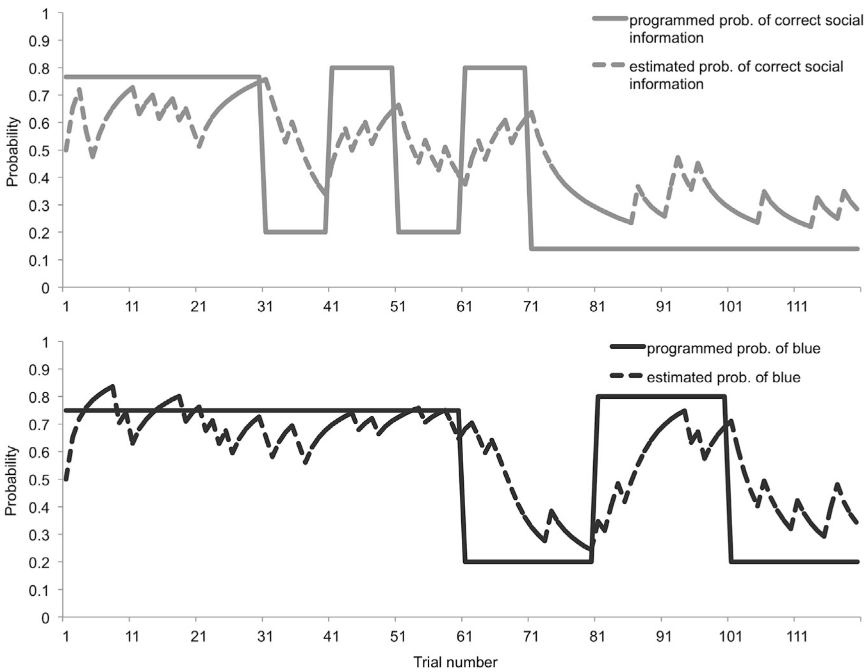

Figure 2. Social and Individual Bayesian Learner Models

To create the social (dashed gray line) and individual (dashed black line) learner models, trial outcomes and social information were used as inputs to a Bayesian learner model algorithm. The model generated estimates (dashed lines) of the underlying probability (solid lines) that blue was rewarded (bottom) and that the social information was useful (top). The illustrated example concerns randomization Group 1 (see Supp. Exp. Proc. 2 in Supplemental Experimental Procedures for randomization details).

The results of experiments 1 and 2 identify a "social dominance paradox": socially dominant individuals, who are typically characterized as having strong beliefs about the importance of individual accountability, and who highly value their own opinions and abilities [1], are nonetheless more likely than low SD individuals to rely on social information and to copy others. However, thus far, aside from referring to previous literature, we have provided no direct evidence that SD individuals explicitly value individual accountability. To investigate whether this is indeed the case, we ran a third experiment in which 34 participants (age mean = 23.38, SEM = 0.81) completed the SD subscale and a novel task. This task estimated the value that participants assigned to individual (private) and social information by requiring them to pay for this information (Figure 4). The aim of experiment 3 was to index spontaneous individual differences in the "baseline" values attributed to social and private information; thus, in contrast to experiments 1 and 2, there was no clear optimal strategy because this might bias social and/or private information valuation. SD (mean = 3.77, SEM = 0.17) was positively correlated with the value attributed to individual (Pearson's r = 0.40, p = 0.02, significant at Bonferroni-corrected α of 0.025), but not social (r = 0.21, p = 0.25), information (Figure S2). Thus, the results of experiment 3 confirm the existence of a social dominance paradox: when asked to make explicit judgments, socially dominant individuals assign a high value to private information, but when they are in the thick of a complex decision-making task, they make extensive use of social information.

In sum, we found that socially dominant people explicitly value independence (experiment 3) but show an enhanced reliance, relative to subordinate individuals, on social learning when in a complex decision-making situation (experiment 1). In our decision-making task, fruitful strategies for utilizing the social information flipped between matching and actively nonmatching the group's choice. SD individuals utilized a matching, but not a nonmatching, strategy and employed this strategy only when the red frame represented social, not

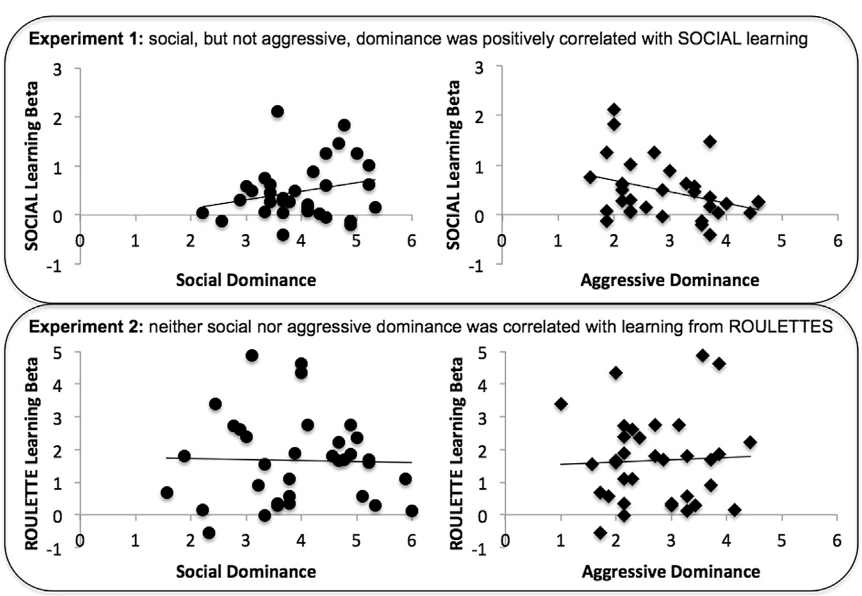

Figure 3. Dominance and Learning Beta Correlations

Y axes show social (experiment 1) or roulette (experiment 2) learning betas; x axes show social dominance or aggressive dominance. Whereas social dominance was significantly positively associated with social learning betas, aggressive dominance was not. Neither of the forms of dominance were predictive of roulette learning betas. See also Figure S1.

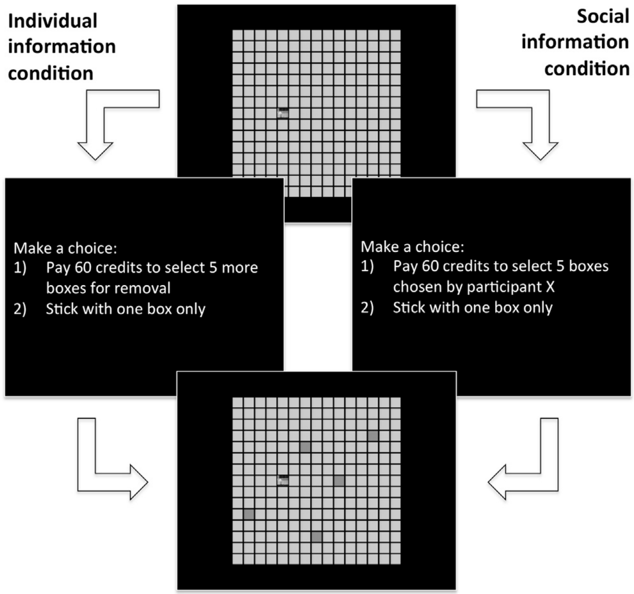

Figure 4. Subjective Valuation Task

The aim was to guess whether a hidden picture was a face, house, car, or scene. Each correct guess earned 100 credits. The task comprised two phases: a selection phase and a guessing phase. In the selection phase, participants were presented with a 15 × 15 grid, one box of which was missing to reveal part of a hidden picture. Participants then decided whether to complete the subsequent guessing phase with just one box missing or pay credits to have five additional boxes removed in the guessing phase. In the Individual information condition, the additional boxes were selected by the participants themselves, and in the Social information condition, they were selected by previous participants. Credit stores started at 0, and participants were informed that credits spent in the selection phase would be deducted from profits from the guessing phase. Each condition comprised six levels varying in the cost of additional information (0, 15, 30, 45, 60, or 75 credits). There were 5 trials per pay level and thus 30 trials per condition. In the guessing phase, the boxes selected in the selection phase were removed, and participants indicated whether the hidden picture was a face, house, car, or scene.

asocial (roulette), information, arguing against a general tendency to match. In contrast, people who are aggressively dominant did not show a bias toward social learning.

Although much is known about the population-level functions of social learning [15], very few studies have investigated the individual-level psychological mechanisms (C.M.H. and J. Pearce, unpublished data) or attempted to explain why people vary widely in their susceptibility to social influence [16–18]. The current series of experiments begins to parse this interindividual variability using a personality-psychology approach and shows, for the first time, that dominance is an important factor. These data challenge the lay stereotype that all dominant individuals ignore the views of others [2]. The more subtle perspective offered by our findings may aid the development of interventions, which maximize learning within organizations and in the classroom, by accounting for the learner's personality characteristics.

Experimental Procedures

Materials and Procedure

In experiment 1, participants completed subjective rating scales [1, 3] of SD and AD, strength of social support network [19], and socioeconomic status (SES) [20], enabling us to investigate the relationship between dominance and learning while controlling for social support and SES.

Subsequently, participants completed the computerized decision-making task [4]. Correct choices were rewarded with points represented on a bar spanning the bottom of the screen. Participants' aim was to obtain a silver (£2) or gold (£4) reward. Before participants made their choice, a red frame appeared that represented the most popular choice from two males and two females who had completed the task previously. Participants were informed that previous attempts had been "juggled" such that "in some phases, they won't seem very useful—for example, they could be guesses from the very beginning of the task when they had little experience. In other phases, however, they will seem quite useful—for example, responses from later in the task when they had had the opportunity to practice a bit more." In animal studies of dominance and social learning, subjects typically observe and do not compete with models [6, 7]. Therefore, to maintain consistency between the animal and human literatures, our cover story avoided the introduction of a one-on-one competitive context (e.g., Behrens et al. [4]).

The study was conducted in accordance with the 1964 Declaration of Helsinki (local ethics committee code: PSYETH[UPTD] 12/13 59).

Data Analysis

Using a Bayesian learner model [5], we computed the individual learner model by integrating the observed choices and outcomes [5], estimating the underlying trial-by-trial probability that blue was rewarded. The social learner model was estimated from the observed veracity of the advice in each trial. Here, the model generates estimates, which were used to weight the group's choice, of the underlying probability that the social information was correct. Binomial logistic regression was used to estimate the degree to which both models explained each participant's choices, resulting in an individual and social learning beta for each participant.

To investigate whether dominance was predictive of learning strategy, we used individual and social betas as dependent variables in two separate regression models. Both models comprised two predictor variables of interest (SD and AD) and five predictors of no interest (age, gender, randomization, social support, and SES). See Supp. Exp. Proc. 7 in Supplemental Experimental Procedures for normality tests.

Supplemental Information

Supplemental Information includes Supplemental Experimental Procedures, two figures, and two tables and can be found with this article online at http://dx.doi.org/10.1016/j.cub.2014.10.014.

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