LEBS
Vol. 15 No. 2 (2024) 31–36
Letters on Evolutionary Behavioral Science

Conformist Bias in an Information Seeking Situation: The Between-Participants Design Replication Study

Mako Fujikawa*, Kunihiro Yokota, Daisuke Nakanishi

Hiroshima Shudo University, 1-1-1, Ozuka-higashi, Asaminami-ku, Hiroshima 731-3195, Japan

*Author for correspondence (mfujikaw@alpha.shudo-u.ac.jp)

The purpose of this study is to investigate whether conformist bias can be observed in information-seeking situations. We replicated the experiment conducted by Fujikawa et al. (2024), in which conformist bias was observed, using a between-participants design. In Experiments 1 (N = 116) and 2 (N = 157), participants responded to "yes/no" questions in which the answer was objectively and not objectively fixed as correct or incorrect. After being shown one of four patterns of hypothetical others' responses (9, 6, 3, or 0 others answering "yes"), participants answered the same questions. The results of both Exp. 1 and Exp. 2 showed a conformist bias for the questions with objectively fixed answers, but not for the questions with non-objectively fixed answers. The differences between the results of Fujikawa et al. (2024) and our results were discussed.

Keywords
conformity, conformist bias, nonconformist-bias

Introduction

Evolutionary anthropologists and psychologists (e.g., Henrich & Boyd, 1998; Kameda & Nakanishi, 2002) have reported that conformity is an adaptive behavior in the information-seeking situations with high uncertainty. In particular, they have argued that conformity is the fundamental psychological mechanism not only for acquiring correct information (micro level) but also for building culture (macro level). Boyd and Richerson (1985) proposed the psychological tendency to be sensitive to majority behavior, namely conformist bias to accelerate these effects at both levels. Conformist bias refers to the imitation behavior that most group members adopt with the probability that exceeds the proportion that members use in deciding their behavior (Boyd & Richerson, 1985). For example, in a situation where a majority of members (e.g., 60%) within a group adopt a certain behavior, individuals with a conformist bias will imitate the behavior of the majority with a probability (e.g., 70%) that exceeds that percentage. Assuming that the majority's judgment is correct in many cases, Boyd and Richerson (1985) argued that conformist bias could be more beneficial to individuals than no biased conformist in terms of acquiring correct information.

Research using an evolutionary simulation has provided theoretical support for conformist bias (e.g., Henrich & Boyd, 1998; Kameda & Nakanishi, 2002). However, empirical research on conformist bias (e.g., Coultas, 2004; McElreath et al., 2008; Morgan et al., 2012; Muthukrishna et al., 2016) has reported conformist bias (e.g., Deffner et al., 2020) and no conformist bias (e.g., Claidière et al., 2012). Eriksson and Coultas (2009) showed no conformist bias in their experiment in which participants saw the responses of hypothetical other participants and then, answered the questions asking for beliefs and preferences (e.g., "Thornton's chocolates are better than Green and Black's.")

The limitation of Eriksson and Coultas (2009) is that the questions they used in the experiment were about beliefs and preferences (attitude questions). Conformist bias is adaptive when individuals seek correct information (cf. Boyd & Richerson, 1985).

On the other hand, Fujikawa et al. (2024) demonstrated conformist bias by replicating Eriksson and Coultas (2009), using not only attitude questions but also questions whose answers were objectively defined (objective questions). However, in their experiment, conformist bias was observed for both objective and attitude questions. They argued that these results could be due to an experimental design (Fujikawa et al., 2024). In Fujikawa et al. (2024), the four patterns of other hypothetical participants' responses were presented to participants simultaneously (within-participant design), whereas in Eriksson and Coultas (2009), one of the four patterns was presented randomly (between-participant design). The within-participant design in the presentation of others' responses might induce an experimenter effect making participants feel that they should conform to the majority because the order of the four patterns of others' responses was the same in all questions.

We conducted two replications of Fujikawa et al. (2024) in which one of the four response patterns of hypothetical nine other participants was randomly presented (between-participants design) for students (Exp. 1) and crowd workers (Exp. 2). Our hypothesis was that conformist bias would be observed for the objective questions with a correct rate above 50% (Hypothesis 1) [1]. In addition, Deutsch and Gerard (1955) proposed two types of conformity motivation, informative influence (conformity motivated to obtain correct information) and normative

[1] Since we found that the analysis methods described in AsPredicted (https://aspredicted.org/dt3up.pdf) were not appropriate to test our hypothesis, the methods used in Fujikawa et al. (2024) were adopted in this analysis. Their methods followed closely those of Eriksson and Coultas (2009).

doi: 10.5178/lebs.2024.118
Received 19 April 2024.
Accepted 16 July 2024.
Published online 13 September 2024.

influence (conformity motivated to be accepted by others). In this study, we also measured these two motivations for conformity, and examined the relationships between participants' responses and the motivations. Thus, our Hypothesis 2 was that responses to objective questions in the situation where participants are presented with others' answers should be motivated by informative influence (Hypothesis 2). We pre-registered the study using AsPredicted (https://aspredicted.org/dt3up.pdf).

Methods

Participants

One hundred and forty-four undergraduates from a psychology course participated in Experiment 1 (20 women, 121 men, and 3 neither/not answering, mean age: 19.04, SD = 2.63) and one hundred and fifty-seven monitors from Crowdworks Co., Ltd. (https://crowdworks.co.jp/) participated in Experiment 2 (82 women, 67 men, and 8 neither/not answering, mean age: 38.45, SD = 10.00). The sample sizes of Experiment 1 and Experiment 2 were taken from Fujikawa et al. (2024). The experimental reward was that participants received class credit (Exp. 1) and 150 yen (about $1, Exp. 2).

Procedure

In both Experiments 1 and 2, we used Qualtrics XM (https://www.qualtrics.com/) web-based survey method that included the following three procedures. First, participants read and agreed to an informed consent form and responded to objective and attitude questions (Fujikawa et al., 2024) by "yes/no" (personal responses). Second, participants were randomly presented with one of four patterns of hypothetical nine participant responses (9, 6, 3, or 0 participants said "yes"). They were then asked to answer the same questions again. The presentation manipulation followed the method of Eriksson and Coultas (2009). Finally, participants then completed the conformity orientation scale as a five-point scale (1: not true – 5: true). To ensure that participants answered each item seriously, participants also answered one item of the Directed Questions Scale (DQS: Miura & Kobayashi, 2018) when answering personal responses and the conformity orientation scale in both experiments. Each experiment lasted 10 minutes. In Experiment 1, the debriefing was conducted by the lecturer in charge of the class, and in Experiment 2, the debriefing was shown on a webpage after all participants completed the survey.

Scales

(a) Objective & attitude questions

We used objective questions (9 items, e.g., "Tokyo is the third smallest prefecture in Japan in terms of area") and attitude questions (5 items, e.g., "Meiji's chocolates are better than Morinaga's") as in Fujikawa et al. (2024). Objective questions satisfied the assumption that the correct rate was above 50%, indicating that the majority of answers were correct. We used Eriksson and Coultas's (2009) questions as the attitude questions but some were modified to fit Japanese culture.

(b) Conformity orientation scale

The conformity orientation scale, which includes the 13 items measuring normative influence and 10 items assessing informative influence was used (Yokota & Nakanishi, 2011).

(c) DQS items

We used the DQS items (Miura & Kobayashi, 2018). The item for personal responses was "For this question, please choose the 'no' option," and the item for the conformity orientation scale was "For this question, please choose the '5' option." In the following analysis, we deleted the data of participants who did not answer these items correctly.

The numerical index of conformist bias (D) & models*

D*, which was developed by Eriksson and Coultas (2009), is calculated from the correct/support rate of participants' responses to each pattern of hypothetical nine other participants (cf. Fujikawa et al., 2024). A positive value of D* indicates a conformist bias, where the increment in the majority's influence on participants' behavior gradually increases (Figure 1: S-curve), while a negative value indicates a nonconformist-bias, where the increment gradually decreases (Figure 1: inverted S-curve), as reported by Eriksson and Coultas (2009). D* = 0 indicates no biased conformist that the majority's influence is proportional.

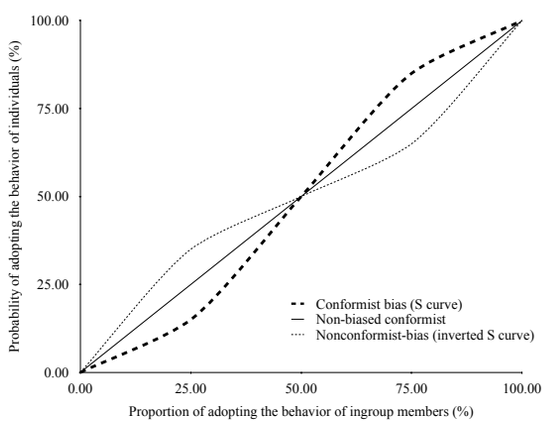

Figure 1. The three conformist models.

$$f(s) = p_0 + (p_1 - p_0)s - 2(p_0 + p_1 - 2p_{neutral})s(1 - s) + Ds(1 - s)(2s - 1) \quad (1)$$

$$f_{\text{null}}(s) = p_0 + (p_1 - p_0)s - 2(p_0 + p_1 - 2p_{neutral})s(1 - s) \quad (2)$$

In addition, we performed polynomial model fitting using the model developed by Eriksson and Coultas (2009) to test whether participants' behavior in these experiments followed a conformist bias. For the polynomial model fitting, we used the biased conformist model (1) and the no biased conformist (proportional) model (2). These models include the parameters s that indicate the four patterns of the ratio of the responses of the hypothetical nine respondents. p_0 denotes the correct/support rate when all other members did not answer "yes," p_1 denotes the correct/support rate when all other members answered "yes," and p_{neutral} denotes the ratio of personal responses. In addition, the biased conformist model also includes the parameter D, which is the average of the D* of each item in each of objective and attitude questions. Thus, the biased conformist model is a cubic equation. On the other hand,

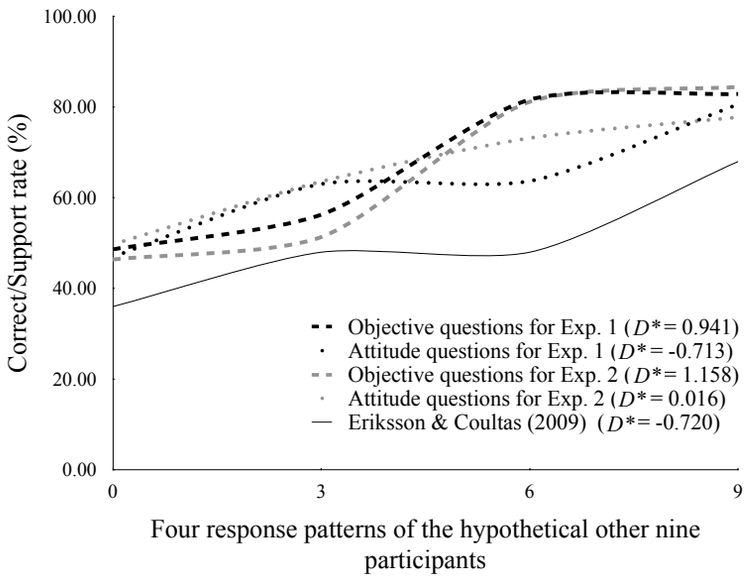

Figure 2. The correct/support rate computed from responses that participants answer objective and attitude question in the situation where were presented the four response patterns of the hypothetical other nine participants (Exps. 1 and 2).

Note: In this figure, the positive value of D^* means conformist bias, $D^* = 0$ indicates no biased conformist, and the negative value shows nonconformist-bias.

the no biased model is a quadratic equation that removes D from the biased conformist model (see Natsumeda et al., 2023 for detail). We tested which models fit the data better in the experiment.

We computed the participants' correct/supportive probability in each pattern of others' responses by assigning to these models the predicted value of the biased and no biased conformist models from the objective and attitude questions in each experiment and the D^* computed from the data. We then compared the AIC between the biased conformist model and the no biased conformist model. Our prediction was that the value of D^* should be positive for objective questions and that the AIC of the biased conformist model would be lower than that of the no biased conformist model.

Results

R 4.3.2 (R Core Team, 2023) was used for analyses in both experiments. The significance level was 5% for all analyses.

Participants for analysis

In the analysis of Experiment 1, data that may have been produced by the same person (4 men) or data of those who did not respond appropriately to the DQS items (4 women, 20 men) were removed. Thus, data from116 undergraduates (16 women, 97 men, 3 neither/none, mean age 18.88, SD = 0.80) were used in this analysis. No data were removed in Experiment 2.

The correct/support rate in personal responses

Table 1 and Figure 2 show the correct/support rate in objective and attitude questions in the personal responses of Experiment 1 and 2. In both experiments, the rate was above 50% for almost all items, except for Q13 from attitude questions in Experiment 1 and Q8 from objective questions in Experiment 2 were below.

Conformist bias

We tested whether a conformist bias was observed. Table 1 also shows the D^* of each item. In the objective questions, one out of nine items in each experiment were negative in D^*. On the other hand, in the attitude questions, three out of five items (in both Exp. 1 and 2) were negative in D^*. We calculated the 95% confidence intervals using the bootstrap method in each question of Experiments 1 and 2 to test whether D^* was positively greater than zero. [2] The results showed that the confidence intervals of neither objective questions (95% CI [0.46, 1.75]) in Experiment 1 nor in Experiment 2 (95% CI [0.36, 1.44]) included zero, while those of attitude questions included zero in Experiment 1 (95% CI [−1.64, 0.10]) and in Experiment 2 (95% CI [−0.40, 1.06]).

Model fitting

We tested the fit of the participants' responses to the biased conformist model and to the no biased model. The results of both experiments showed that in both questions, the AIC of the biased conformist model (Exp. 1: objective questions: AIC = −43.68; attitude questions: AIC = −16.28, Exp. 2: objective questions: AIC = −25.74; attitude questions: AIC = −18.01) was smaller than the no biased conformist model (Exp. 1: objective questions: AIC = −33.62; attitude questions: AIC = −13.96, Exp. 2: objective questions: AIC = −16.96; attitude questions: AIC = −15.73). Taken together, these results supported Hypothesis 1 that conformist bias would be observed in objective questions.

[2] The D^* shown in Table 1 is the averaged value on a per-item basis for comparison with the results of Eriksson and Coultas (2009). Meanwhile, the D^* used in a bootstrap method is the averaged value on a per-participant basis to test whether participants showed conformist bias.

Table 1. The correct or support rate and *D** value in objective and attitude questions (Exps. 1 and 2).

	Items	Exp.	$r_{neutral}$	r_0	N	r_{13}	N	r_{23}	N	r_1	N	D^*
Q1	How to read “ 七転び八起き ” is “nanakorobi yaoki” in Japanese. (yes)	Exp.1	90.52%	71.43%	28	76.92%	26	93.33%	30	96.88%	32	0.54
		Exp.2	95.54%	76.32%	38	92.31%	39	95.00%	40	95.00%	40	−0.24
Q2	How to read “ 茨城県 ” is “ibaraki ken” in Japanese. (yes)	Exp.1	66.38%	50.00%	34	60.71%	28	68.00%	25	79.31%	29	−0.17
		Exp.2	78.34%	70.00%	40	64.10%	39	84.62%	39	79.49%	39	1.17
Q3	Dry ice makes from solid hydrogen. (no)	Exp.1	82.76%	77.42%	31	75.00%	28	82.76%	29	89.29%	28	0.26
		Exp.2	75.80%	60.53%	38	65.00%	40	84.62%	39	90.00%	40	0.66
Q4	Strawberries are the sweetest near the heft. (no)	Exp.1	81.03%	70.00%	30	70.00%	30	83.33%	30	76.92%	26	0.74
		Exp.2	78.98%	57.50%	40	65.00%	40	86.84%	38	82.05%	39	0.92
Q5	How to read “ 狡い ” is “zurui” in Japanese. (yes)	Exp.1	62.07%	37.93%	29	46.67%	30	74.07%	27	80.00%	30	0.90
		Exp.2	68.79%	45.00%	40	58.97%	39	82.05%	39	92.31%	39	0.49
Q6	The colors of the Bulgarian flag consist of white, green, and red. (yes)	Exp.1	69.83%	28.00%	25	46.43%	28	83.87%	31	87.50%	32	1.19
		Exp.2	52.23%	28.21%	39	22.50%	40	84.62%	39	69.23%	39	3.27
Q7	How to read “ 遊説 “ is “yuuzetsu” in Japanese. (no)	Exp.1	55.17%	37.50%	32	52.17%	23	76.67%	30	67.74%	31	0.97
		Exp.2	66.88%	37.50%	40	47.37%	38	79.49%	39	85.00%	40	1.10
Q8	Tokyo is the third smallest prefecture in Japan in terms of area. (yes)	Exp.1	67.24%	34.38%	32	42.86%	28	90.00%	30	88.46%	26	1.97
		Exp.2	45.22%	22.50%	40	23.68%	38	71.79%	39	85.00%	40	1.84
Q9	New Zealand’s population (December 2019) is under 10 million. (yes)	Exp.1	60.34%	31.03%	29	35.71%	28	82.76%	29	80.00%	30	2.07
		Exp.2	50.32%	20.00%	40	23.08%	39	61.54%	39	82.05%	39	1.20
Q10	DIY instructions should have images rather than text.	Exp.1	89.66%	75.86%	29	80.65%	31	93.10%	29	92.59%	27	0.46
		Exp.2	94.90%	72.50%	40	92.31%	39	87.18%	39	100.00%	39	−0.96
Q11	Pigeons spread disease.	Exp.1	50.86%	34.62%	26	52.00%	25	50.00%	34	83.87%	31	1.24
		Exp.2	53.50%	37.50%	40	35.90%	39	68.42%	38	82.50%	40	1.18
Q12	Ayataka is better than Oi Ocha.	Exp.1	66.38%	42.31%	26	75.86%	29	67.65%	34	70.37%	27	−1.19
		Exp.2	55.41%	42.50%	40	65.79%	38	69.23%	39	60.00%	40	−0.16
Q13	Eating garlic protects you from catching a cold.	Exp.1	46.55%	35.71%	28	43.33%	30	53.85%	26	78.13%	32	−0.24
		Exp.2	67.52%	52.50%	40	67.50%	40	71.79%	39	76.32%	38	−0.25
Q14	Meiji’s chocolates are better than Morinaga’s.	Exp.1	69.83%	46.43%	28	63.33%	30	53.85%	26	78.13%	32	−1.35
		Exp.2	57.96%	43.59%	39	56.41%	39	69.23%	39	70.00%	40	0.27
Q1-Q9 (Objective questions)		Exp.1	70.59%	48.63%	270	56.28%	249	81.64%	261	82.90%	264	0.94
		Exp.2	68.01%	46.39%	355	51.33%	352	81.17%	351	84.46%	355	1.16
Q10-14 (Attitude questions)		Exp.1	64.66%	46.99%	137	63.03%	145	63.69%	149	80.62%	149	−0.71
		Exp.2	65.86%	49.72%	199	63.58%	195	73.17%	194	77.76%	197	0.02
Total		Exp.1	68.47%	48.04%	407	58.69%	394	75.23%	410	82.08%	413	0.35
		Exp.2	67.24%	47.58%	554	55.71%	547	78.32%	545	82.07%	552	0.75

Note: $r_{neutral}$: the correct or support rate computed from responses that participants answer objective and attitude questions in personal responses; r_0, $r_{1/3}$, $r_{2/3}$, r_1, the correct or support rate computed from responses that participants answer objective and attitude questions in the situation where were presented the four response patterns of the hypothetical other nine participants (9, 6, 3, 0 said “yes”).

Motivations

To examine the motivations behind conformity, we calculated a conformity score from participants' responses to the four patterns of hypothetical other participants' responses. One point was added to participants' conformity scores if they responded in agreement with the majority (e.g., participants responded "yes" if nine or six other participants responded "yes" and "no" if three or zero other participants responded "yes"). If participants disagreed with the majority, they received a score of zero. The range of scores was zero to nine for objective questions and zero to five for attitude questions.

Because the internal consistency of the two subscales of the conformity orientation scale was sufficient in both experiments (normative influence: αs > .83, informative influence: αs > .61), we summed the scores of all items on the normative (range was 13 to 65) and the informative influence (range was 10 to 50) scales for each. The results of Experiment 1 showed significant positive correlations between the conformity score on the objective questions and both normative and informative influence scales (rs > .31). In Experiment 2, the conformity score was positively correlated with the normative influence score (r = .29), whereas there was no significant correlation with the informative influence (r = .15, *ns*). These results provided partial support for Hypothesis 2. In both experiments, no significant correlations were found between conformity scores on attitude questions and each type of conformity (rs < .16, *ns*).

Discussion

This study aimed to replicate the Fujikawa et al. (2024) experiment using a between-participants design to examine whether conformist bias can be observed in information-seeking situations, following the procedure of Eriksson and Coultas (2009). The results showed a conformist bias for most objective questions, but a nonconformist-bias for attitude questions. The finding of nonconformist-bias for attitude questions is consistent with the findings of Eriksson and Coultas (2009), but the finding that conformist bias was only observed for objective questions differs from the findings of Fujikawa et al. (2024). These results support our hypothesis that the conformist bias should be observed in the situation for acquiring of correct information. However, our data have a limitation in explaining why our results are inconsistent with the results of a within-participant design study (Fujikawa et al., 2024). We should explore the determinants of this inconsistency in the future.

Some results of this study were also inconsistent with the results of Fujikawa et al. (2024). The objective questions for Q2 in Experiment 1 and Q1 in Experiment 2 showed negative D^* values calculated for each item. The attitude questions for Q10 and Q11 in Experiment 1 and Q11 and Q14 in Experiment 2 has positive D^* values. This inconsistency between two experiments is difficult for us to interpret properly because we do not have sufficient results in this study. Furthermore, there were no correlations between conformity scores for objective questions and informative influence in Experiment 2. This may be due to the reliability of the conformity orientation scale. Confirmatory factor analysis revealed that some of the informative influence items in the data from this study had the lower factor loadings. This finding is consistent with the results of the confirmatory factor analysis in Fujikawa et al. (2024), but inconsistent with the results of Yokota and Nakanishi (2011). The results of this study and Yokota and Nakanishi (2011) consistently reported the lower alpha coefficients of the informative influence scale, ranging from .62 to .70. Therefore, a valid and reliable conformity orientation scale should be a priority.

There are three limitations to this study. The first limitation is the logic of Hypothsis 1. The reason why we proposed the hypothesis that conformist bias should be observed in the situation where the correct rate is above 50% is rational for the individuals with high conformist bias. However, the results that individuals conform to the majority when responding the questions with no correct answers have also been found. Therefore, we should consider the logic of Hypothesis 1 carefully.

The second limitation of this study is that we did not directly test the adaptive value of conformist bias, as we did not measure participants' choices at the behavioral level and did not provide incentives to obtain correct information. We should replicate the experiment by measuring a choice behavior and providing financial incentives (Muthukrishna et al., 2016) to acquire correct information.

The third limitation includes the validity of the items (questions) used to calculate the D^* value in this study. To estimate the appropriate D^* values, items should be randomly sampled from a population of them. Furthermore, when testing the null hypothesis for D^*, random effects of items should be included to reduce the inflation of Type I error (Judd et al., 2012; Murayama et al., 2014). In the next studies, we should adopt these points to test whether conformist bias is observed using D^* values. Additionally, there is another alternative explanation for the classification of questions as objective or attitude (e.g., Q11 and Q13 are classified as attitude questions, but some individuals may perceive them as objective). Finally, the number of objective questions was not equal to the number of attitude questions.

Acknowledgments

This study was supported by the Japan Society for the Promotion of Science (grant number 20K03323).

Author contribution

MF analyzed the data, DN and KY supervised this study, DN developed the study concept and design, MF, KY and DN wrote the manuscript.

Ethical statement

The ethics review of this study was previously approved by the ethics committees of the university to which the authors belong (approval number 2021-0007).

Data accessibility & program code

The materials and R-script used in this experiment are published in Open Science Framework (https://osf.io/jngs2/).

References

Boyd, R., & Richerson, P. J. (1985). *Culture and the evolutionary process*. University of Chicago Press.

Claidière, N., Bowler, M., & Whiten, A. (2012). Evidence for weak or linear conformity but not for hyper-conformity in an everyday social learning context. *PloS ONE*, *7*(2), Article e30970. https://doi.org/10.1371/journal.pone.0030970

Coultas, J. C. (2004). When in Rome... An evolutionary perspective on conformity. *Group Processes & Intergroup Relations*, *7*(4), 317–331. https://doi.org/10.1177/1368430204046141

Deffner, D., Kleinow, V., & McElreath, R. (2020). Dynamic social learning in temporally and spatially variable environments. *Royal Society Open Science*, *7*, Article 200734. https://doi.org/10.1098/rsos.200734

Deutsch, M., & Gerard, H. B. (1955). A study of normative and informational social influences upon individual judgment. *The Journal of Abnormal and Social Psychology*, *51*(3), 629–636. https://doi.org/10.1037/h0046408

Eriksson, K., & Coultas, J. C. (2009). Are people really conformist-biased? An empirical test and a new mathematical model. *Journal of Evolutionary Psychology*, *7*(1), 5–21. https://doi.org/10.1556/JEP.7.2009.1.3

Fujikawa, M., Yokota, K., Tokuoka, M., & Nakanishi, D. (2024). Can conformity bias be observed in questions whose answers are objectively fixed? *The Japanese Journal of Psychology*, *94*(6), 506–511. https://doi.org/10.4992/jjpsy.94.22334

Henrich, J., & Boyd, R. (1998). The evolution of conformist transmission and the emergence of between-group differences. *Evolution and Human Behavior*, *19*(4), 215–241. https://doi.org/10.1016/S1090-5138(98)00018-X

Judd, C. M., Westfall, J., & Kenny, D. A. (2012). Treating stimuli as a random factor in social psychology: A new and comprehensive solution to a pervasive but largely ignored problem. *Journal of Personality and Social Psychology*, *103*(1), 54–69. https://doi.org/10.1037/a0028347

Kameda, T., & Nakanishi, D. (2002). Cost–benefit analysis of social/cultural learning in a nonstationary uncertain environment: An evolutionary simulation and an experiment with human subjects. E*volution and Human Behavior*, *23*(5), 373–393. https://doi.org/10.1016/S1090-5138(02)00101-0

McElreath, R., Bell, A. V., Efferson, C., Lubell, M., Richerson, P. J., & Waring, T. (2008). Beyond existence and aiming outside the laboratory: Estimating frequency-dependent and pay-off-biased social learning strategies. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *363*, 3515–3528. https://doi.org/10.1098/rstb.2008.0131

Miura, A., & Kobayashi, T. (2018). Influence of satisficing on online survey responses. *The Japanese Journal of Behaviormetrics*, *45*(1), 1–11. https://doi.org/10.2333/jbhmk.45.1

Morgan, T. J. H., Rendell, L. E., Ehn, M., Hoppitt, W., & Laland, K. N. (2012). The evolutionary basis of human social learning. *Proceedings of the Royal Society B: Biological Sciences*, *279*, 653–662. https://doi.org/10.1098/rspb.2011.1172

Murayama, K., Sakaki, M., Yan, V. X., & Smith, G. M. (2014). Type I error inflation in the traditional by-participant analysis to metamemory accuracy: A generalized mixed-effects model perspective. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *40*(5), 1287–1306. https://doi.org/10.1037/a0036914

Muthukrishna, M., Morgan, T. J. H., & Henrich, J. (2016). The when and who of social learning and conformist transmission. *Evolution and Human Behavior*, *37*(1), 10–20. https://doi.org/10.1016/j.evolhumbehav.2015.05.004

Natsumeda, M., Yokota, K., & Nakanishi, D. (2023). Can conformity bias transcend domain specificity under social dilemma situations? *Letters on Evolutionary Behavioral Science*, *14*(2), 43–47. https://doi.org/10.5178/lebs.2023.108

R Core Team (2023). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/

Yokota, K., & Nakanishi, D. (2011). Dōchō shikō shakudo no sakusei: Kihanteki eikyō to jōhōteki eikyō [Development of the conformity orientation scale: Informative and normative influence]. *Studies in the Humanities and Sciences*, *51*(2), 23–36. https://shudo-u.repo.nii.ac.jp/record/1012/files/KJ00006996319.pdf