

Reciprocity-Norm Similarity and Cooperative Investment Within Friendships

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Cooperation among non-kin is sustained through repeated interactions and expectations of future reciprocity. The present study examined whether perceived similarity in reciprocity norms was associated with helping within established friendships and whether this association varied with helping cost. Participants were 255 Japanese adults who identified a same-gender friend living nearby and rated their perceived similarity to that friend in reciprocity norms, other moral concerns, physical appearance, tastes, and values. They also reported past low- and medium-cost help provided to and received from the friend and anticipated helping in hypothetical high-cost situations. Primary analyses controlling for relationship characteristics indicated that reciprocity-norm similarity was significantly associated with the provision of low-cost help (emotional support), but not with medium- or high-cost helping or help received. Exploratory FDR-adjusted analyses indicated that similarities in physical appearance and tastes were associated with helping in some higher-cost contexts. These findings suggest that perceived similarity in reciprocity norms may signal compatibility in cooperative decision rules and guide low-cost cooperative investment within established friendships.

Keywords

moral similarity, altruistic behavior, reciprocity norms, helping costs, moral foundations, cooperative relationships

Introduction

Evolutionary theories have identified several conditions under which helping can be favored, including genetic relatedness and repeated reciprocal interactions. The present study focuses on the latter context: cooperation among non-kin within ongoing social relationships. Reciprocal altruism requires repeated interactions, opportunities for future exchange, and expectations about future behavior (Trivers, 1971). These conditions are particularly characteristic of friendships, in which individuals repeatedly decide how much effort, time, and resources to devote to particular partners.

Previous research has emphasized partner choice in cooperative relationships. People prefer altruistic and cooperative individuals and tend to help them (e.g., Oda, 2026; Oda & Hayashi, 2024), and cooperative individuals are more likely to be chosen as partners for future interactions (Barclay, 2016; Barclay & Willer, 2007). Such partner-choice processes may generate assortative relationships among individuals with similar cooperative tendencies. However, the allocation of cooperative investment within established relationships presents a different problem. Once a friendship has been established, individuals must continue to decide how much to invest in that particular partner.

One factor that may guide these decisions is perceived similarity in reciprocity norms. Investing in a partner involves uncertainty about how that partner will behave in future interactions. Differences in reciprocity norms may increase the risk of exploitation, whereas perceived similarity may indicate that partners apply similar standards regarding cooperative obligations and the return of favors. Thus, the proposed mechanism is not that stronger reciprocity norms necessarily promote cooperation. Rather, perceived similarity may reduce uncertainty about future interactions by signaling compatibility in the decision rules governing reciprocal exchange. Because such similarity is information used by an individual making an investment decision, it may be more strongly associated with help provided to a friend than with help received from that friend. Importantly, the present study assessed similarity as perceived by the participant, not by the friend. Such perceived similarity may therefore be most directly relevant to the participant's own decision to invest in the relationship, reflected in help provided to the friend. Its association with help received may be less direct because this depends on the friend's investment decision, and whether the friend similarly perceives compatibility in reciprocity norms is unknown.

However, an association between reciprocity-norm similarity and helping could reflect a broader tendency to favor similar others. Similarity in attitudes, preferences, values, and group memberships is associated with helping, trust, and cooperation (e.g., Bekkers, 2010; Curry & Dunbar, 2013; Oates & Wilson, 2002), and personal moral norms predict prosocial behavior (Capraro & Perc, 2021; Capraro & Rand, 2018). To distinguish reciprocity-specific similarity from moral similarity more generally, we used Moral Foundations Theory (MFT; Graham et al., 2011; Haidt, 2012), which provides a framework for comparing distinct domains of moral concern. We assessed perceived similarity in care, loyalty, authority, and purity, excluding fairness because of its conceptual overlap with reciprocity. We also assessed similarities in physical appearance, tastes, and values to compare moral similarity with broader forms of similarity.

The present study examined whether perceived similarity in reciprocity norms was associated with

helping within an established friendship. Participants identified a same-gender friend living nearby and reported perceived similarity to that friend and past and anticipated helping. We examined whether perceived reciprocity-norm similarity was associated with help provided to and received from the friend, with the expectation that its association would be more directly evident for help provided, and whether these associations varied across three levels of helping cost. By comparing reciprocity-norm similarity with other forms of perceived similarity, we examined whether compatibility in reciprocity norms is specifically associated with cooperative investment within established friendships.

Methods

(1) Procedure

Participants were first asked online whether they had any friends or acquaintances of the same gender living nearby whom they could meet immediately if they wished. Only those who answered yes proceeded to subsequent questions. Participants were asked to designate one such individual as the target person. They then answered questions about their relationship with the target and rated the similarity between themselves and the target, relative to others in general, in terms of moral beliefs and other characteristics. Subsequently, participants reported how often they had provided help to and received help from the target over the previous two months. Finally, participants read hypothetical scenarios and judged whether they would help the target and whether they expected to be received help from the target. The study was conducted via the online platform *PsyToolkit* (Stoet, 2010, 2017).

(2) Questionnaire

Relationship with the Target: Participants reported (1) the age difference between themselves and the target (in years), (2) residential distance (in kilometers; values were $\log_{10}$ -transformed to reduce distortion from extreme distances), (3) current contact frequency on a seven-point scale (1 = never meet, 7 = meet daily), (4) expected contact frequency over the next year on a seven-point scale (1 = probably never meet, 7 = very frequently), and (5) expected opportunity for contact one year later on a seven-point scale (1 = no possibility at all, 7 = very high possibility).

Relationship characteristics were included as control variables because opportunities and expectations for future interaction are known to influence helping and reciprocal cooperation independently of perceived similarity. Controlling for these variables allowed us to examine whether perceived similarity explained additional variance beyond the structural characteristics of the friendship.

Similarity in Norms: Participants estimated how similar their agreement with reciprocal norm and each of the four moral foundations was to that of the target, using a nine-point scale (1 = not at all similar, 9 = extremely similar). The question regarding the reciprocity norm was one item: "If someone does something for you, you should return the favor". Because the full Moral Foundations Questionnaire (MFQ) was too lengthy for this survey, one representative item was constructed for each foundation, with reference to Graham et al. (2011) and Haidt (2012). These items were

as follows: "You should not do things that are disgusting, even if no one is harmed" for Purity, "You must be loyal to the group to which you belong" for Loyalty, "You must have compassion for those who are suffering or in trouble" for Care, and "You should conform to the traditions of your society" for Authority.

Similarity Beyond Norm: Participants rated their similarity to the target in terms of appearance, tastes, and values using nine-point scales (1 = not at all similar, 9 = extremely similar).

Altruism: Measures followed Stewart-Williams (2007). Low-cost help consisted of emotional support. Medium-cost help consisted of five items: help during illness, help during crises, help with everyday living, help with housing, and financial help. Participants rated how often they had provided or received each type of help over the previous two months using nine-point scales (1 = never, 9 = often). High-cost help was assessed using two hypothetical scenarios involving drowning at sea and kidney donation. Participants rated both their willingness to help and their expectation of receiving help on nine-point scales.

(3) Analyses

Participants completed the task separately for each scenario. The participant-level score for medium-cost helping was defined as the median across the five medium-cost scenarios. Likewise, the participant-level score for high-cost helping was defined as the median across the two high-cost scenarios.¹⁾ Response variables were treated as ordinal and analyzed using ordinal logistic regression. All explanatory variables were standardized. Because perceived similarity in reciprocity norms was theoretically central to the present hypotheses, we treated its effects across the six models (help received and help provided $\times$ three levels of cost) as the primary tests and applied a Bonferroni-corrected significance threshold of $p < .008$ (.05/6). Effects of the other predictors were treated as exploratory. To evaluate these effects while controlling for multiple testing without the conservativeness of Bonferroni correction, we additionally applied the Benjamini-Hochberg false discovery rate (FDR) procedure (Benjamini & Hochberg, 1995) separately within each model, treating the 13 predictor tests as a single family. The FDR threshold was set at $q < .10$.

Help received from (or expected from) friends was strongly correlated with help provided to (or expected to be provided to) them ($r_s = .70-.84$; Table 1). Because our primary aim was to examine predictors of cooperative investment rather than helping conditional on reciprocal help, we did not include received and provided help as predictors of each other. Moreover, because both were reported by the same participant, these correlations should not be interpreted as direct evidence of behavioral reciprocity.

(4) Participants

Because no similar prior studies were available and the statistical power of ordinal logistic regression depends on factors such as the distribution of the ordinal outcome variable, it was difficult to determine the required sample size *a priori*. Therefore, we estimated the required sample

size by referring to power analyses for multiple linear regression. A power analysis conducted using G*Power 3.1.9.2 indicated that a sample of 182 participants would be required to detect a medium effect size ($f^2 = .15$) with 80% power, 13 predictors, and an alpha level of .008.

A total of 324 Japanese adults were recruited through Cross Marketing, Inc. After excluding participants who failed the attention check and/or did not complete all items, data from 255 individuals (126 females, 127 males, 2 others; median age = 39 years, range = 20–59) were analyzed.

Results

Descriptive statistics of explanatory variables are shown in Table S1. Bivariate correlations among all parameters are shown in Table 1. Variance inflation factors (VIFs) ranged from 1.06 to 3.01. Although some shared variance was present among predictors, these values remained below conventional thresholds, suggesting that multicollinearity was unlikely to fully explain the observed effects. The results of multiple ordinal logistic regression analyses indicated that the factors contributing to help received (or expected to be received) differed depending on the cost of helping behavior (Table 2). No variables significantly predicted low-cost help received. For medium-cost help received, similarity in appearance and similarity in tastes showed positive associations ($ps = .003$), although these effects were exploratory using FDR analyses (Table S2). These results indicate that participants tended to receive medium-cost assistance from friends with similar appearances and preferences. For high-cost help expected to be received, only similarity in tastes emerged as a significant positive predictor. An exploratory analysis of the effects of all variables using FDR-adjusted p -values showed that expected opportunity for contact one year later, as well as tastes, was significant predictors of high-cost help expected to be received (Table S2).

The predictors of help provided also varied by cost category (Table 3). For low-cost help provided, perceived similarity in reciprocity norms showed a significant positive association ($p = .001$), meeting the Bonferroni-corrected threshold for the primary tests, suggesting that participants were more likely to offer emotional support to friends who shared similar views regarding reciprocal norms. FDR-adjusted p -values showed that expected contact frequency over the next year, as well as reciprocal norm was significant predictors of low-cost help provided (Table S2). For medium-cost help provided, similarity in appearance was the only significant positive predictor. For high-cost help willing to provide, only similarity in tastes significantly predicted willingness to help.

We conducted nested model comparisons to examine predictors of help provided. Model comparisons indicated that adding similarities in the four moral foundations and in appearance, tastes, and values significantly improved the fit of the model predicting low-cost help beyond relationship variables alone (Table S3–S5). Adding similarity in reciprocal norm also significantly improved the fit of the model, $LR\chi^2(1) = 10.77, p < .001$, accompanied by a reduction in AIC from 1027.4 to 1018.6.

Discussion

The present study examined whether perceived similarity in various characteristics, particularly reciprocity norms, was associated with helping toward friends. Consistent with this hypothesis, perceived similarity in reciprocity norms was significantly and positively associated with the provision of low-cost help. However, it was not significantly associated with the provision of medium- or high-cost help. An exploratory analysis using FDR-adjusted p -values showed that expected contact frequency over the following year was also significantly associated with low-cost help. Participants tended to provide more emotional support to friends whom they perceived as similar in their views on reciprocity and to friends with whom they expected more frequent contact over the following year. Notably, this association was not observed for similarity in the other moral concerns assessed in the study. This pattern suggests that the association with low-cost helping may not simply reflect moral similarity in general, although the present analyses did not directly compare the magnitudes of these effects.

The present findings concern cooperative investment within established friendships rather than the formation of friendship ties. Reciprocal altruism requires repeated interactions and opportunities for future exchange, making friendships a particularly relevant ecological context. Perceived similarity in reciprocity norms was associated with the provision of low-cost help, whereas no significant association was observed with help received. One possible explanation for this pattern is that similarity was assessed from the participant's perspective. Perceived compatibility in reciprocity norms can directly inform the participant's own decision to invest in a friend, whereas help received depends on the friend's decision and potentially on the friend's own perception of compatibility, which was not assessed in the present study. This interpretation remains tentative, however, because the study did not assess both partners' perceptions or directly compare their decision processes. Rather than supporting a simple exchange-based account of reciprocal altruism, the findings suggest that perceived similarity in reciprocity norms may serve as cues that guide investment decisions within cooperative relationships. Traditional accounts of reciprocal altruism often emphasize behavioral symmetry: Individuals help those who help them. However, such symmetry may be neither necessary nor sufficient for maintaining reciprocal cooperation. Reciprocal systems can accommodate substantial short-term imbalances as long as interactions occur within long-term relationships governed by shared expectations.

The present findings support a decision-rule account of reciprocity: What matters is not the immediate equality of exchange but compatibility in the internalized norms that regulate obligations and repayment. Perceived similarity in reciprocity norms may therefore serve as a cue to compatibility in cooperative decision rules. When individuals perceive that a partner endorses similar standards regarding the return of favors and the avoidance of free riding, they may invest in that relationship with greater confidence that cooperation will be sustained over time.

An exception to this general pattern was medium- and high-cost helping. Medium-cost helping may depend more

Table 1
Correlations between each parameter

Parameter	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Low-cost help, received	.476**	.197**	.695**	.399**	.210**	.052	-.006	.188**	.255**	.239**	.256**	.256**	.306**	.289**	.300**	.126*	.327**	.377**
2. Medium-cost help, received		.316**	.487**	.843**	.231**	.132*	-.013	.384**	.375**	.135*	.022	.259**	.061	.269**	.103	.311**	.307**	.232**
3. High-cost help, expected to be received			.125*	.195**	.768**	.014	-.020	.095	.103*	.220**	.093	.229**	.170**	.220**	.138*	.177**	.336**	.294**
4. Low-cost help, provided				.507**	.137*	.022	.050	.259**	.328**	.296**	.152*	.197**	.213**	.183**	.284**	.157*	.298**	.326**
5. Medium-cost help, provided					.114*	.018	.088	.378**	.343**	.129*	-.021	.185**	.000	.153*	.045	.379**	.264**	.173**
6. High-cost help, willing to provide						-.019	-.025	.036	.061	.219**	.222**	.182**	.277**	.230**	.217**	.088	.302**	.283**
7. Age difference							-.039	.128*	.121*	.007	-.003	-.014	-.055	.027	-.132*	.039	.042	.003
8. Distance								-.160*	-.107*	.078	-.018	-.049	-.023	-.066	.002	.066	.027	.053
9. Current contact									.777**	.419**	.017	.154*	.032	.087	.042	.151*	.260**	.202**
10. Expected contact										.532**	.106*	.135*	.067	.159*	.072	.110*	.277**	.231**
11. Opportunity											.257**	.175**	.254**	.197**	.238**	.134*	.314*	.292**
12. Purity												.219**	.632**	.332**	.582**	-.080	.231**	.273**
13. Loyalty													.383**	.575**	.328**	.239**	.316**	.440**
14. Care														.390**	.591**	-.026	.214**	.326**
15. Authority															.450**	.194**	.362**	.457**
16. Reciprocal norm																-.014	.207**	.319**
17. Appearance																	.350**	.334**
18. Tastes																		.618**
19. Values																		

Note. $N = 255$. Values are Spearman's rank-order correlations except for correlations between dependent variables, which are Pearson correlations. * $p < .05$. ** $p < .01$.

Table 2
Regression of the parameters on help received or expected to be received

a. Low-cost help

Parameter	β	<i>SE</i>	<i>z</i>	<i>p</i>	Odds ratio	95% CI
Relationship						
Age difference	0.031	0.120	0.262	.793	1.03	0.81–1.30
Distance	0.019	0.113	0.169	.865	1.02	0.81–1.27
Current contact	0.016	0.176	0.091	.927	1.02	0.71–1.43
Expected contact	0.304	0.191	1.593	.111	1.35	0.93–1.96
Opportunity	0.031	0.143	0.216	.829	1.03	0.77–1.36
Morality						
Purity	0.007	0.162	0.043	.965	1.01	0.73–1.38
Loyalty	0.076	0.151	0.506	.613	1.08	0.80–1.45
Care	0.327	0.168	1.941	.052	1.39	0.99–1.92
Authority	0.048	0.157	0.308	.757	1.05	0.77–1.42
Reciprocal norm	0.281	0.162	1.742	.081	1.32	0.96–1.81
Appearance	0.121	0.129	0.932	.351	1.13	0.87–1.45
Tastes	0.311	0.149	2.090	.036	1.36	1.01–1.82
Values	0.212	0.160	1.322	.186	1.24	0.90–1.69

AIC = 1028.88

b. Medium-cost help

Parameter	β	<i>SE</i>	<i>z</i>	<i>p</i>	Odds ratio	95% CI
Relationship						
Age difference	0.237	0.134	1.772	.076	1.27	0.97–1.64
Distance	0.085	0.125	0.682	.495	1.09	0.85–1.38
Current contact	0.264	0.191	1.382	.167	1.30	0.89–1.89
Expected contact	0.306	0.206	1.488	.137	1.36	0.90–2.03
Opportunity	−0.155	0.152	−1.018	.308	0.86	0.63–1.15
Morality						
Purity	−0.274	0.167	−1.635	.102	0.76	0.54–1.05
Loyalty	0.219	0.155	1.416	.156	1.24	0.91–1.68
Care	−0.025	0.170	−0.149	.881	0.98	0.69–1.35
Authority	0.215	0.164	1.315	.188	1.24	0.89–1.70
Reciprocal norm	0.145	0.170	0.853	.393	1.16	0.82–1.61
Appearance	0.408	0.140	2.907	.003	1.50	1.14–1.97
Tastes	0.476	0.163	2.923	.003	1.61	1.16–2.21
Values	−0.190	0.174	−1.091	.275	0.83	0.58–1.16

AIC = 905.19

Table 2 Continued

c. High-cost help

Parameter	β	<i>SE</i>	<i>z</i>	<i>p</i>	Odds ratio	95% CI
Relationship						
Age difference	0.090	0.108	0.833	.404	1.09	0.88–1.35
Distance	−0.074	0.116	−0.639	.522	0.93	0.73–1.16
Current contact	−0.130	0.179	−0.729	.465	0.88	0.61–1.24
Expected contact	0.018	0.189	0.093	.926	1.02	0.70–1.47
Opportunity	0.356	0.140	2.540	.011	1.43	1.08–1.88
Morality						
Purity	−0.127	0.158	−0.804	.421	0.88	0.64–1.19
Loyalty	0.202	0.148	1.364	.172	1.22	0.91–1.63
Care	0.057	0.162	0.353	.724	1.06	0.77–1.45
Authority	0.094	0.159	0.589	.555	1.10	0.80–1.50
Reciprocal norm	0.083	0.153	0.541	.588	1.09	0.80–1.46
Appearance	0.124	0.127	0.976	.329	1.13	0.88–1.45
Tastes	0.535	0.156	3.421	< .001	1.71	1.25–2.31
Values	0.130	0.167	0.782	.434	1.14	0.82–1.57

AIC = 1264.31

Note. The significance threshold for the six primary tests of reciprocal-norm similarity was $p < .008$.

Table 3

Regression of the parameters on help provided or willing to provide

a. Low-cost help

Parameter	β	<i>SE</i>	<i>z</i>	<i>p</i>	Odds ratio	95% CI
Relationship						
Age difference	−0.045	0.119	−0.377	.706	0.96	0.75–1.20
Distance	0.141	0.115	1.233	.217	1.15	0.92–1.44
Current contact	−0.051	0.174	−0.291	.770	0.95	0.67–1.33
Expected contact	0.491	0.190	2.584	.009	1.63	1.12–2.36
Opportunity	0.182	0.142	1.287	.198	1.20	0.90–1.58
Morality						
Purity	−0.351	0.160	−2.191	.028	0.70	0.51–0.96
Loyalty	0.086	0.148	0.585	.558	1.09	0.81–1.45
Care	0.232	0.160	1.456	.145	1.26	0.92–1.72
Authority	−0.233	0.154	−1.511	.130	0.79	0.58–1.07
Reciprocal norm	0.543	0.167	3.259	.001	1.72	1.24–2.38
Appearance	0.165	0.127	1.294	.195	1.18	0.91–1.51
Tastes	0.300	0.153	1.958	.050	1.35	0.99–1.82
Values	0.254	0.163	1.557	.119	1.29	0.93–1.77

AIC = 1018.62

Table 3 Continued**b. Medium-cost help**

Parameter	β	<i>SE</i>	<i>z</i>	<i>p</i>	Odds ratio	95% CI
Relationship						
Age difference	0.013	0.130	0.099	.921	1.01	0.78–1.30
Distance	0.257	0.125	2.053	.040	1.29	1.01–1.65
Current contact	0.400	0.193	2.071	.038	1.49	1.02–2.17
Expected contact	0.199	0.207	0.961	.336	1.22	0.81–1.83
Opportunity	–0.172	0.155	–1.109	.267	0.84	0.62–1.14
Morality						
Purity	–0.204	0.168	–1.211	.226	0.82	0.58–1.13
Loyalty	0.113	0.157	0.719	.472	1.12	0.82–1.52
Care	0.113	0.172	0.656	.511	1.12	0.79–1.56
Authority	–0.073	0.157	–0.468	.639	0.93	0.68–1.26
Reciprocal norm	0.106	0.174	0.609	.542	1.11	0.79–1.56
Appearance	0.572	0.139	4.128	< .001	1.77	1.35–2.32
Tastes	0.238	0.161	1.476	.139	1.27	0.92–1.73
Values	–0.238	0.174	–1.370	.170	0.79	0.56–1.10

AIC = 861.34

c. High-cost help

Parameter	β	<i>SE</i>	<i>z</i>	<i>p</i>	Odds ratio	95% CI
Relationship						
Age difference	0.071	0.109	0.647	.517	1.07	0.86–1.32
Distance	–0.071	0.116	–0.611	.541	0.93	0.74–1.16
Current contact	–0.109	0.178	–0.614	.538	0.90	0.63–1.27
Expected contact	–0.067	0.191	–0.350	.726	0.94	0.64–1.36
Opportunity	0.282	0.143	1.972	.048	1.33	1.00–1.75
Morality						
Purity	0.147	0.163	0.900	.368	1.16	0.84–1.59
Loyalty	0.009	0.150	0.058	.953	1.01	0.75–1.35
Care	0.287	0.170	1.695	.090	1.33	0.95–1.85
Authority	0.015	0.155	0.100	.920	1.02	0.74–1.37
Reciprocal norm	0.011	0.153	0.069	.944	1.01	0.74–1.36
Appearance	0.025	0.128	0.198	.843	1.03	0.79–1.31
Tastes	0.494	0.159	3.104	.001	1.64	1.19–2.23
Values	0.135	0.163	0.828	.407	1.14	0.83–1.57

AIC = 1227.61

Note. The significance threshold for the six primary tests of reciprocal-norm similarity was $p < .008$.

heavily than low-cost helping on practical constraints such as available resources, time, and situational opportunities, potentially reducing the role of reciprocity-norm similarity. High-cost helping involved rare hypothetical situations with limited opportunities for reciprocal exchange, under which other forms of perceived similarity may be more relevant. These interpretations remain tentative, however, because the cost categories differed in both the types of help assessed and, for high-cost helping, the use of hypothetical rather than past behavior. Thus, the observed differences cannot be attributed to helping cost alone.

Several limitations warrant consideration. First, the present design does not permit causal inferences about the direction of the observed associations. Perceived similarity in reciprocity norms may promote helping, helping relationships may foster perceptions of similarity, or both processes may reinforce each other over time. Second, the present study assessed perceived rather than actual similarity. From a social decision-making perspective, perceived compatibility may itself have important psychological consequences. Nevertheless, future research should directly assess both partners' moral beliefs and examine the effects of actual similarity. Third, perceived similarity in the present study was assessed using a single item. Although this approach was intended to reduce participant burden, single-item measures may have limited reliability. The present findings should therefore be interpreted with caution, and future research should employ more comprehensive measures of perceived similarity.

In conclusion, the present research advances our understanding of how moral psychology interfaces with evolutionary mechanisms that sustain cooperation. Rather than simply reflecting short-term behavioral symmetry, perceived similarity in reciprocity norms appears to be associated with how individuals allocate cooperative investment within established friendships, particularly in the context of low-cost helping. By serving as a cue to compatibility in cooperative decision rules, perceived similarity in reciprocal norms may contribute to the maintenance of long-term cooperative bonds in everyday social life.

Notes

1) The results of the item-level regression analyses are presented in Tables S6–S9.

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Author contribution

Ryo Oda: Conceptualization, Data curation, Funding acquisition, Investigation, Visualization, Project administration, Writing – original draft (lead), Writing – review and editing (equal). **Tensei Tanaka:** Investigation, Software, Formal analysis, Writing – original draft (supporting), Writing – review and editing (equal).

Ethical statement

This study design was approved by the Bioethics Review Committee of Nagoya Institute of Technology (No. 2024-3).

Data accessibility & program code

Electronic supplementary materials are available online.

Supplementary material

Electronic supplementary materials are available online.

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