**Testing the similarity-projection hypothesis using the reaction time paradigm:
Anchoring and adjustment in social judgments**

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Abstract

People often project their mental states to others whom they perceive to be similar to themselves. Tamir and Mitchell (2013) examined this similarity-projection hypothesis through the reaction time paradigm and demonstrated a positive relationship between the reaction time of others' mental state judgments and the distance of judgments from the participants' mental states as evidence of using projection. However, their methodology was limited, and the robustness of the paradigm was not well examined. The results of three studies employing different types of tasks and target persons based on Tamir and Mitchell (2013) supported the hypothesis; the reaction time positively predicted the distance of judgments when a target was perceived to be similar to participants. Although, when this relationship was observed in Study 3, the target person was perceived to be not only similar but also dissimilar. We discussed that these results suggested a boundary condition of the similarity-projection hypothesis.

Keywords: mental states inference, projection, anchoring and adjustment, reaction time

Introduction

Similarity-projection hypothesis

Although people's mental states such as emotion, desire, and preference are unobservable directly, successful mental state inference is important for navigating through the social world. Psychologists (e.g., Malle & Hodges, 2005) and philosophers (e.g., Nichols & Stich, 2003) agree that two different processes could be used for making mental state inferences. One process is projection (Ames, 2004a, b; Nickerson, 2001; Waytz & Mitchell, 2011). In this the unobservable mental states of others are inferred by projecting one's own mental states. False consensus effect, which is a well-known cognitive bias to overestimate own preference, is considered as an evidence of using projection (Ross, Greene, & House, 1977; see Marks & Miller, 1987; Robbins & Krueger, 2005 for reviews). People who project their own mental states onto others imagine what they would feel, think, and act should they be the ones whose mental states are inferred (Van Boven & Loewenstein, 2003). As a result, those who use projection tend to judge that the other person thinks and behaves like themselves.

Ames (2004a, b) further proposed the similarity-projection hypothesis. It states that projection is more likely to be used when the target person's mental state would be inferred as similar to the self. Projection is used in mental state inferences because it is an informative heuristic. When personality traits, gender, ages, or any other attributes of a target person are similar to oneself, it is likely that both share many preferences. Thus, it is rational to project one's own mental states onto others who are similar when no other information is immediately available for judging the latter's mental state. When attributes of the target are dissimilar to oneself, it is likely that both share few similar preferences. Therefore, employing category-based information (e.g., stereotype) becomes a better strategy. This strategy is called stereotyping, and it is the second process to make mental state inferences.

This similarity-projection hypothesis has been tested empirically and supported (e.g., Ames, 2004a; Tamir & Mitchell, 2013; Todd, Simpson, & Tamir, 2016). For instance, Ames (2004a) asked participants to rate their agreements about multiple items

describing the mental states of three different people in the same situation. These are the mental states of a target person in a social situation (target item, e.g., Steve, a lawyer, feels bad about explaining the solution, which his teammates contributed to finding, to his boss without his teammates), their own possible mental state in the same situation (self-item, e.g., if I were in the same situation as Steve, I would feel bad about explaining the solution to my boss without my teammates), and likely mental state of a typical relevant group member (group item, e.g., typical lawyers feel bad about explaining the solution to their boss without their teammates). A multiple regression analysis revealed that responses to the self-items predicted better responses to the target items when the target person is perceived to be similar to participants (i.e., projection). When the target person is perceived to be dissimilar to participants, the responses to the target items was better predicted by the responses to the group items (i.e., stereotyping).

From correspondence to response time

Although the correlation or correspondence between judgments about the mental states of others and oneself is considered as an evidence of utilizing projection (e.g., Ames, 2004a, b; Schul & Vinokur, 2000; Todd et al., 2016), a dissenting view recently emerged. Clement and Krueger (2000) indicated that correlations can also arise from introjection, which is a process of judging one's own mental state based on the inferred others. Recently, a group of researchers rigorously modeled the cognitive processes of mental state inference by utilizing projection as the combined processes of anchoring and adjustment, and they concluded that the correlations per se are only the indirect evidence of projection (Ames, 2004a, study 3; Clement & Krueger, 2000; Tamir & Mitchell, 2013). For example, when estimating a numerical value such as weight or temperature, people often set an anchor, which is an initial value of inference, and gradually adjust estimates based on other information obtained (e.g., Tversky & Kahneman, 1974). Similarly, projection could be considered as the process of setting one's own mental state as an anchor.

Tamir and Mitchell (2013) demonstrated anchoring and adjustment processes during social judgment with the reaction time paradigm. Assuming that adjustment is a

process demanding cognitive efforts, it is expected that the reaction time for making judgments about others' mental states increases as adjustments made from the anchor expand. Accordingly, if one's own mental state is used as anchor, the reaction time of others' mental states judgment is predicted to be positively correlated with the degree of discrepancy between inferred other's and one's own mental state. Moreover, if the similarity-projection hypothesis is correct, this relationship is observed when the mental state of similar others is inferred. Tamir and Mitchell (2013) described two fictional target persons to their participants and asked them to create a series of judgments about the preferences or habits of the target persons (e.g., how likely does she or he "enjoy winter sports such as skiing or snowboarding" or "fear speaking in public"). Responses were measured with a Likert scale, and reaction times were recorded. The similarity of the target persons to the participants was manipulated (similar or dissimilar to participants). Participants were also asked to make judgments about their own preferences and habits with the same items and scale (e.g., Do you likely "enjoy winter sports such as skiing or snowboarding," "fear speaking in public"). The results supported their hypothesis, that is, the greater the differences score (i.e., distance between the responses to the target person and the self on a Likert scale calculated for each item), the longer the reaction time. This relationship was found only when the target person was similar to the participants.

The anchoring and adjustment processes of projection are consistent with the correlation of judgments about others' preference with the participant's own (e.g., false consensus effect). Judgment value often tends to be near the anchor (Epley & Gilovich, 2006) because adjustment requires cognitive effort and it is difficult to adjust inference value from an anchor sufficiently. A positive correlation between anchors (i.e., one's own mental state) and adjusted values (i.e., inferred other's mental state) then emerges.

Task-independence of the similarity-projection hypothesis

As described above, a large number of studies have revealed that people employ projection as a mental state inference strategy. Theoretically, projection should be widely employed as a strategy for inferring the mental states of others when they are perceived

1 to be similar to oneself. Although Tamir and Mitchell (2013) accumulated empirical data
2 to support their hypothesis, their experiments were conducted in limited settings.

3 First, Tamir and Mitchell (2013) asked participants to judge their own or a target
4 person's preferences or habits. This task requires participants to recall their self-
5 knowledge to judge. Previous projection-related studies employed a different task. For
6 example, Ross et al. (1977) asked participants to judge whether the target person would
7 agree to carry a sandwich board around campus. In this instance, one cannot answer using
8 self-knowledge because it is quite unlikely that most have been in this situation. Thus,
9 one needs to imagine being in a particular situation and spontaneously generate self-
10 knowledge rather than recalling from memory.

11 Second, past studies on projection have shown that the descriptions of the target
12 person vary from abstract in- or out-group members (Ames, 2004b; Robbins & Krueger,
13 2000; Ross et al., 1977) and concrete but fictional individuals (Ames, 2004a; Clement &
14 Krueger, 2000) to those of the participants actual friends (Satvitsky, Keysar, Epley, Carter,
15 & Swanson, 2011). By contrast, Tamir and Mitchell (2013) displayed the target person
16 only as a real individual. An Internet dating profile of the same person was repeatedly
17 presented across their three experiments, and the target was described as a politically
18 liberal college student who resided in the same area as the participants. Such differences
19 in the amount of information about the target would be essential especially when inferring
20 the mental state of dissimilar others as stereotyping, which is a category-based knowledge,
21 is predicted to be used in such situation.

23 **Current study**

24 In this study, we aimed to examine the robustness of the reaction time paradigm
25 for testing the similarity-projection hypothesis.

26 First, instead of asking participants to recall their habits or preferences that have
27 been formulated in advance, we instructed them to respond to questions that they have
28 not encountered much in the past. In the experiments, participants completed a preference
29 judgment task in which they were presented questions with two options. They made
30 judgments to identify what they (self-block) and the target person preferred (other-person

block). Contrary to previous studies that employed the reaction time paradigm, we asked participants to respond to a series of forced binary choice questions. Most of them had never answered such questions, therefore reflecting upon their self-knowledge from memory was restrained (e.g., “which foreign country do you want to visit: Kazakhstan or Uzbekistan?”, “in which bank do you want to create your savings account: Tomato Bank or Momiji (a Japanese maple) Bank?”). In both examples, the Japanese adolescents were unfamiliar with the options.

Second, we also varied the abstraction level of descriptions of the target persons. We employed an actual friend of the participants in Study 1, and people in a website, an approach similar to that of Tamir and Mitchell (2013) in Study 2. In Study 3, a fictional individual was used as the target person (Ames, 2004a). We examined whether a longer reaction time in the preference judgment about the target person predicts inconsistency between judgments in the self and other-person blocks despite the differences described by Tamir and Mitchell (2013).

Study 1

In Study 1, a close friend and a student from a university different than the participants were employed as similar or dissimilar others. These target others were manipulated as a between-participant condition. Participants were randomly assigned to one of the conditions and were asked to complete an identical set of 40 preference judgment questions for both the target person (other-person block) and themselves (self-block). We examined whether the reaction time in the other-person block correlated with the consistency of judgments between blocks. We then predicted that the length of reaction time correlated with the inconsistency of judgments only in the similar condition.

Method

Participants

A total of 61 undergraduates and graduates at Sophia University in Japan participated in Study 1 (44 female, 17 male). Participants were randomly assigned to the

similar ($n = 34$) and dissimilar conditions ($n = 30$). These sample sizes were equivalent to those of Tamir and Mitchell (2013) in which 25 (Studies 1 and 2a) and 53 (Studies 2b) participants were recruited (The similarity of the target was a within-participant factor across the three studies).

Preference Judgment Task

We developed 40 questions (e.g., which foreign country do you want to visit: Kazakhstan or Uzbekistan?, “in which bank do you want to create your savings account: Tomato Bank or Momiji (a Japanese maple) Bank?”), each with two options that the participants were unlikely to have compared, thereby preventing them from responding based on their self-knowledge.

Procedure

Upon arriving in the laboratory, participants were seated in front of a computer where they filled a consent form. First, the experimenter prompted participants to imagine a particular person as target for both conditions. In the similar condition, they were asked to recall one of their close friends and provide her or his age and initials. In the dissimilar condition, participants were instructed to imagine a prototypical student from the Tokyo Institute of Technology. By contrast to most students at Sophia University who are female majoring in humanities, students of the Tokyo Institute of Technology are mostly male majoring in science and technology. Hence, the participants were likely to perceive students of the Tokyo Institute of Technology as the unfamiliar out-group members, thereby making them an appropriate candidate of the target person in the dissimilar condition.

Next, the experimenter gave participants the instruction on the preference judgment task. The instruction indicated that three types of information would be presented on the computer screen: the person cue (“self,” “friend,” or “student”), the question (“which foreign country do you want to visit?”), and the two options (“Kazakhstan” and “Uzbekistan”). Participants were then asked to infer which options the

1 person on the top cue would prefer by typing D (left option) or K (right option) as quickly
2 as possible.

3 Participants then completed 80 preference judgment questions. In the beginning,
4 they finished three practice trials for each self- and other-person blocks, followed by two
5 blocks of 80 preference questions. The order of the blocks was counterbalanced, whereas
6 the order of the questions was randomized within each block.

7 On each trial, a fixation (center of the screen) and the person cue (top of the screen)
8 were simultaneously presented for 1000 msec. Fixation disappeared simultaneously as a
9 question was presented at the center. After 1500 msec, two options were presented until
10 participants pushed either the D or K key. The position of options was counterbalanced
11 across participants. Reaction time was measured from the presentation of options to the
12 pressing of answer key. The interval between the consecutive trials was set to 1000 msec.
13 We used Inquisit ver. 3.0.5.0 by Millisecond Software for the preference judgment task.
14

15 **Result and discussion**

16 For each participant, 40 questions were classified as either consistent (0) or
17 inconsistent item (1) based on whether the choices in the identical question correspond
18 with the self- and other-person blocks. We conducted a generalized linear mixed model
19 (GLMM) on this choice consistency index using the lme4 and lmerTest packages on R
20 version 3.2.4 with logit link function and binomial distribution. The model included
21 reaction time, which was log-transformed and standardized following Tamir and Mitchell
22 (2013), target person (similar other = 0, dissimilar other = 1), block order (other-first = 0,
23 self-first = 1), all interaction effects as fixed factors, and participants and questions as
24 random factors.

25 Results revealed significant effects of the target person ($b = .54$, $CI_{95\%} = [.11, .96]$,
26 $z = 2.48$, $p = .013$, $OR = 1.71$) and block order ($b = .40$, $CI_{95\%} = [.02, .77]$, $z = 2.06$, p
27 $= .040$, $OR = 1.49$). When the target person differed from a participant (or when the self
28 -block was first conducted), the responses to preference judgment questions were more
29 likely to be inconsistent across blocks. In addition, the effect of reaction time ($b = .34$,
30 $CI_{95\%} = [.07, .62]$, $z = 2.45$, $p = .014$, $OR = 1.41$) and the interaction between reaction

time and block order were significant ($b = -.43$, $CI_{95\%} = [-.74, -.12]$, $z = -2.72$, $p = .007$, $OR = 0.65$). As reaction time increased, the responses were more likely to become inconsistent, and this relationship was stronger in the other-first condition ($b = .21$, $CI_{95\%} = [-.04, .46]$, $z = 1.65$, $p = .100$, $OR = 1.23$) than in the self-first condition ($b = -.06$, $CI_{95\%} = [-.21, .10]$, $z = -0.71$, $p = .479$, $OR = 0.95$). However, the expected interaction between the target person and reaction time was not significant ($b = -.24$, $CI_{95\%} = [-.66, .18]$, $z = -1.11$, $p = .268$, $OR = 0.79$).

[Table 1 insert here]

We then conducted GLMM for each target condition with reaction time and order as fixed factors, and participants and questions as random factors. In the similar condition, the effects of reaction time ($b = .31$, $CI_{95\%} = [.03, .58]$, $z = 2.18$, $p = .029$, $OR = 1.36$) and block order ($b = .38$, $CI_{95\%} = [.01, .75]$, $z = 2.01$, $p = .044$, $OR = 1.47$) were significant. As reaction time increased (or when the self-block was first conducted), the responses were more likely to become inconsistent. The interaction between reaction time and block order was also significant ($b = -.39$, $CI_{95\%} = [-.70, -.08]$, $z = -2.45$, $p = .014$, $OR = 0.68$), such that the effect of reaction time on choice inconsistency became stronger in the other-first condition ($b = .25$, $CI_{95\%} = [-.03, .53]$, $z = 1.74$, $p = .082$, $OR = 1.28$) than in the self-first condition ($b = -.07$, $CI_{95\%} = [-.22, .09]$, $z = -0.82$, $p = .411$, $OR = 0.94$). In the dissimilar condition, none of the effects were significant (reaction time: $b = .12$, $CI_{95\%} = [-.21, .45]$, $z = 0.73$, $p = .464$, $OR = 1.13$; block order: $b = .34$, $CI_{95\%} = [-.08, .75]$, $z = 1.60$, $p = .111$, $OR = 1.40$; interaction: $b = -.15$, $CI_{95\%} = [-.52, .23]$, $z = -0.76$, $p = .446$, $OR = 0.86$).

[Table 2 insert here]

These results partially support the hypothesis. Based on Tamir and Mitchell (2013), we hypothesized that longer reaction times in the other-person block correlated with frequencies of inconsistent judgments between the other-person and self-blocks in the

similar condition only. This finding was confirmed in Study 1 when data for the similar and dissimilar conditions were analyzed separately. Although this predicted effect was obtained only in the other-first condition and we did not explicitly predict this order effect, this result was in line with previous studies (Tamir & Mitchell, 2013; Robbins & Krueger, 2005). This finding is further elaborated on in the General Discussion. It is noteworthy that frequencies of response consistency were higher in the similar condition. Thus, when the target person was perceived as similar, participants tended to judge that they and others would choose the same option. This false-consensus-like effect was also observed in previous studies (e.g., Ames, 2004a).

Overall, in Study 1 we found evidence that people use their preference as an anchor when making inferences about the mental state of similar others, which implies that projection strategy was selectively employed in such situation. In Study 2, we modified our methods and tested our hypothesis wherein two persons from a website (Facebook) were employed as the similar or dissimilar others and this was manipulated as a within-participant condition. We also measured the perceived similarity of the target to confirm for manipulation check.

Study 2

Method

Participants

A total of 25 undergraduates from Sophia University (22 female, 3 male) participated in Study 2.

Procedure

After completing a consent form, participants were informed that the purpose of the current study was to investigate how people create an impression about others based on their profile page on social networking sites such as Facebook.

In the same manner as in Study 1, participants were randomly assigned to either the self- or other-first conditions. In Study 2, the similarity of the target person was

manipulated as a within-participant condition. In the other-person block, participants first answered a set of questions for a similar or dissimilar target, then they answered the questions for the other target.

For this study, the number of questions increased to 60. They comprised the same 40 questions used in Study 1 and 20 newly developed questions. Participants answered all 60 questions in the self-block, whereas in the other-person block, they answered 30 randomly selected questions for a similar target and the remaining 30 for the dissimilar target. Three practice trials were added to the first set of questions.

In the other-person block, participants were presented a fictional Facebook profile page (i.e., a fake account created by the authors for purposes of the study). In the similar other condition, a character was described as a same-sex student from Sophia University. This student was born in Hachioji, a city west of Tokyo, graduated from Tokyo Metropolitan Kokusai High School and liked Tokyo Disneyland and the Tokyo Olympics 2020. In the dissimilar other condition, a character was described as a same-sex student from Tokyo Institute of Technology who was born in Fukuoka Prefecture, which is located 1,100 km south-west further from Tokyo, and graduated from Chikushigaoka High School in Fukuoka. The character liked robotics and EFY's Electronics Design Community. In both conditions, the target person was presented as a real person though profile photos with the name were masked.

After presenting the profile page, the experimenter gave the instruction of the preference judgment task and asked participants to answer 30 preference judgment questions of the 60 items. The procedure of the preference judgment task was identical to that of Study 1, except that the person cues displayed on top of the screen were "A-san (meaning Mr. or Ms. A in Japanese)" instead of "Friend" or "Student." After completing the first 30 questions, the Facebook profile page of the second target person was displayed, followed by the rest of the 30 questions. The person cue displayed was replaced with "B-san (meaning Mr. or Ms. B in Japanese)." The order of the similarity conditions (i.e., which character was the first target of the task) was counterbalanced across participants.

In the post-experimental questionnaire, participants rated their perceived similarity to the two targets on a 7-point Likert scale ranging from 1 (not similar at all)

to 7 (very similar). Then, they were asked to recall the hometown and university of the two targets, which they did correctly. Also, they were asked to write about their impression of the targets because the informed purpose of this study was about impression formation although the data from this question were not our focus.

Results and discussion

Manipulation Check

Perceived similarity between targets significantly differed between the two target conditions, and the direction was identical as expected ($M = 4.56$, $SD = 1.04$ for similar target and $M = 2.88$, $SD = 1.20$ for dissimilar target, $t(24) = 4.68$, $p < .001$, $CI_{95\%} = [0.94, 2.42]$, Cohen's $d = 1.52$).

GLMM

GLMM was conducted on the choice consistency index with reaction time (log-transformed and standardized), target person (similar other = 0, dissimilar other = 1), and block order (other-first = 0, self-first = 1) as fixed factors and participants and questions as random factors. The target order (similar- or dissimilar-first) was excluded as parameter estimation did not converge.

This analysis revealed the significant effects of reaction time ($b = .38$, $CI_{95\%} = [.09, .67]$, $z = 2.59$, $p = .010$, $OR = 1.46$) and target person ($b = .81$, $CI_{95\%} = [.51, 1.10]$, $z = 5.38$, $p < .001$, $OR = 2.25$). In addition, we obtained all two- ($ps < .013$) and three-way interaction effects ($b = .97$, $CI_{95\%} = [.50, 1.44]$, $z = 4.02$, $p < .001$, $OR = 2.63$).

[Table 3 insert here]

In the similar condition, the main effect of reaction time was significant ($b = .46$, $CI_{95\%} = [.13, .78]$, $z = 2.78$, $p = .006$, $OR = 1.58$). However, this effect was moderated by block order ($b = -.77$, $CI_{95\%} = [-1.18, -.35]$, $z = -3.65$, $p < .001$, $OR = 0.46$), whereas reaction time negatively predicted response inconsistency as opposed to our hypothesis in the self-first condition ($b = -.30$, $CI_{95\%} = [-.54, -.07]$, $z = -2.54$, $p = .011$, $OR = 0.74$).

Reaction time positively predicted response inconsistency as hypothesized in the other-first condition ($b = .50$, $CI_{95\%} = [.17, .84]$, $z = 2.94$, $p = .003$, $OR = 1.65$). In the dissimilar condition, none of the effects were significant (reaction time: $b = -.19$, $CI_{95\%} = [-.47, .09]$, $z = -1.34$, $p = .179$, $OR = 0.83$; block order: $b = -.25$, $CI_{95\%} = [-.62, .11]$, $z = -1.35$, $p = .177$, $OR = 0.78$; interaction: $b = .28$, $CI_{95\%} = [-.06, .62]$, $z = 1.61$, $p = .107$, $OR = 1.32$).

[Table 4 insert here]

In Study 2, we replicated the main results of Study 1 and found that longer reaction time predicted increasing response inconsistency only for the condition in which participants perceived the target person to be similar to them. We also found the order effect to have a positive relationship between reaction time and response inconsistency and this was obtained only in the other-first condition (see General Discussion). False-consensus-like effect was again observed, wherein higher frequencies of response consistency were found in the similar condition. The core results of Study 1 were successfully replicated despite the differences in the target person (an actual friend or people on Facebook) and experimental design (between or within design) between the two studies. Thus, Study 2 revealed the robustness of the hypothesis.

We further tested the similarity-projection hypothesis with the reaction time paradigm. As described in the Introduction, Ames (2004a) used a fictional person in the short vignette as the target person and measured perceived similarity to participants themselves for testing the hypothesis. We employed this method in Study 3 and predicted that reaction time was positively correlated with response inconsistency only when the perceived similarity was high.

Study 3

Method

Participants

A total of 74 undergraduates at Sophia University (59 female, 15 male) participated in the study.

Procedure

After the participants completed their consent form, they read a vignette about the target person on paper. The following sentences were present on the vignette: “A-san (Mr. A) is a 34-year-old lawyer in Tokyo. He likes going to a coffee house, where he often reads books or studies for his work. He dislikes cigarette smoke and agrees with bans on smoking in bars and coffee houses.” Participants were then asked to rate their perceived similarity to the target person (A-san) using a 7-point Likert scale. This vignette was employed by Ishii and Takezawa (2017). According to them, it was expected that the ratings of participants would be distributed from low to high.

Next, the preference judgment task was conducted. Participants were randomly assigned to either the self- or other-first condition. In the self-first condition, they were instructed about the preference judgment task and they completed three practice trials. They then answered the same 40 questions as in Study 1 for themselves (self-block), followed by the same for the target person (other-person block). In the other-first condition, participants answered both blocks in reverse. The procedure of the preference judgment task was identical with that in Study 1 except for the person cue in the other-person block was “A-san” instead of “the other.”

Results and Discussion

GLMM was conducted on the choice consistency index with reaction time, perceived similarity rating (centered), block order (other-first = 0, self-first = 1), and all the interaction effects as fixed factors. Participants and questions were included in the model as random factors.

The analysis revealed significant effects of reaction time ($b = .27$, $CI_{95\%} = [.12, .43]$, $z = 3.45$, $p = .001$, $OR = 1.31$), perceived similarity ($b = -.24$, $CI_{95\%} = [-.37, -.11]$, $z = -3.58$, $p < .001$, $OR = 0.79$), and block order ($b = .47$, $CI_{95\%} = [.21, .73]$, $z = 3.53$, $p < .001$, $OR = 1.59$). These results implied that when reaction time increased or similarity rating decreased, the responses between blocks were more likely to become inconsistent. Moreover, similar to Studies 1 and 2, responses were more likely to become inconsistent in the self-first condition than the other-first condition. However, all the interaction effects were not significant ($ps > .282$). Following the analyses in Study 1, we estimated the slopes of reaction time and block order on the frequencies of response inconsistency at the two points in which perceived similarity was high (+1 SD) or low (-1 SD). When perceived similarity was high, the main effects of reaction time ($b = .25$, $CI_{95\%} = [.03, .47]$, $z = 2.27$, $p = .023$, $OR = 1.29$) and block order ($b = .58$, $CI_{95\%} = [.22, .93]$, $z = -3.17$, $p = .002$, $OR = 1.78$) were significant. When perceived similarity was low, these effects did not reach the conventional 5% significance level. However, the size of effects was similar when perceived similarity was high (reaction time: $b = .21$, $CI_{95\%} = [-.02, .43]$, $z = 1.82$, $p = .069$, $OR = 1.23$; block order: $b = .29$, $CI_{95\%} = [-.05, .64]$, $z = 1.67$, $p = .095$, $OR = 1.34$).

[Table 5, 6 insert here]

We replicated the main findings of Study 1 in Study 3. The significant positive relationship between reaction time and response inconsistency was observed only when the target was perceived to be similar to the participants. However, it is noteworthy that the results in Study 3 could also be interpreted as contrary evidence to our hypothesis. Unlike the results in Studies 1 and 2, the positive relationship between reaction time and response inconsistency was suggested when the target was perceived to be dissimilar to the participants, although the p value did not reach the criteria .05. This finding indicates that participants of Study 3 employed projection strategy not only when perceived similarity was high but also when it was low. The main difference of Study 3 from Studies 1 and 2 was the use of a brief vignette to present a target person and the measurement of

perceived similarity with a Likert scale. The possibility that these differences facilitated the results of Study 3 is discussed in the General Discussion.

General Discussion

This article examined the robustness of the reaction time paradigm (Tamir & Mitchell, 2013) for testing the similarity-projection hypothesis. Three studies were conducted and the results of Studies 1 and 2 support the hypotheses.

Study 1 mainly differed from the research of Tamir and Mitchell (2013) in two aspects: participants in Tamir and Mitchell's experiments inferred the personalities, preferences, and habits of the characters in an Internet dating website, whereas participants in this study (Study 1) inferred the preferences of their same-sex friends (or typical imaginary students from another university). The preference judgments in our study were presented as a forced binary choice task in which it was highly unlikely that participants had compared the two alternatives previously. Preference judgment tasks in Study 2 were almost identical with those in Study 1. Fake Facebook profiles of target persons were created and this approach was more similar to Tamir and Mitchell's.

Despite these differences, most of their findings were replicated in our studies. Reaction time was correlated positively with response inconsistency between the judgments of participants' own and the target person's preferences only when the target was perceived to be similar to the participant. This positive relationship in the similar target condition supports the similarity-projection hypothesis. People employ the projection strategy during inferring the mental state of others perceived to be similar to them, and the robustness of the reaction time paradigm for testing the similarity-projection was confirmed.

Further, it is noteworthy that the positive relationship between reaction time and response inconsistency was observed only when the judgment of similar target's preference (other-person block) preceded the judgment of participants' preference (self-block). Although Tamir and Mitchell (2013) reported no significant order effect in their studies (i.e., the interaction effect among the order, the reaction time, and similarity were

not statistically significant), this effect was observed in other studies. For example, Robbins and Krueger (2005) conducted a meta-analysis on 19 studies about projection and revealed that people employ the projection strategy strongly when they judge ingroups rather than outgroups. They also reported that projection was stronger when judgment about the target was made first (a small effect of the order of judgment on projection was observed, $\beta = .17$). Moreover, the sample statistics in Tamir and Mitchell's (2013) Studies 2a and 2b do not contradict the order effect; the β , which indicated how strongly the reaction time predicted the response inconsistency, was higher when participants made judgments about similar target first (before the self-condition; $\beta = .20$ in Study 2a, and $.09$ in Study 2b) than when they did last (after the self-condition; $\beta = .11$ and $.04$ in Studies 2a and 2b, respectively). Projection appears more likely to be utilized in the self-first condition because participants who made judgments about themselves first could store them in the memory and easily recall them by activating mental representations of self-knowledge when making judgments about others. This perspective contradicts the results of previous studies as well as ours. Underlying mechanisms of the order effect are unclear yet. Further research is required to confirm whether the order effect is robust and, if the effect surely exists, to explore the cognitive mechanisms underlying such effects.

Study 3, which aimed to replicate the results of employing the research design by Ames (2004a), revealed a positive relationship between reaction time and response inconsistency when a target person was perceived to be similar to participants. However, a similar relationship level was also found when a target was perceived to be dissimilar; although, it failed to reach conventional significance level. Thus, contrary to the results of Studies 1 and 2, the participants in Study 3 could have employed projection during inferences about mental states of dissimilar and similar others.

One significant difference from Studies 1 and 2 is that the similarity of the target person was not experimentally manipulated in Study 3. Participants read the descriptions of the target person (i.e., 34-year-old male lawyer) and rated perceived similarity to themselves using a 7-point Likert scale. We then entered the similarity rating as an independent variable in the analyses. The distribution of the similarity rating scores was

1 somewhat skewed as 64.8% of participants gave a high rating for the target person as
2 being similar to themselves (33 participants gave a rating of 5, 15 gave a rating of 6, and
3 no one gave a rating of 7), whereas only 31.0% rated the target person was dissimilar (11
4 participants gave a rating of 3, 12 gave a rating of 2, and no one gave a rating of 1). This
5 skewed distribution may have influenced the results of Study 3. Another possible
6 explanation could be the scarcity of information about the target person. Study 1
7 participants imagined their real friend or an average university student. Participants in
8 Study 2 were presented with “real” targets through Facebook profile pages (rich
9 information was displayed even though these targets were fictional). Participants in Study
10 3 were presented with only brief sentences that described the target person. Contrary to
11 the target persons in Studies 1 and 2, who were the same-sex and had similar-age
12 characters to participants, the target person in Study 3 was rather unfamiliar to them. Thus,
13 participants in Study 3, unlike those in Studies 1 and 2, possessed limited information
14 that could be used in preference judgments about the target. People have been argued to
15 use projection in making social judgments when information about the target is scarce
16 (Ames, 2005). Thus, participants in Study 3 could have employed projection when
17 inferring dissimilar others.

18 Findings similar to Study 3 were reported by Ishii and Takezawa (2017), who
19 tested the similarity-projection hypothesis with Japanese youth using the same research
20 paradigm as Ames (2004a, Study 1). Participants in Ishii and Takezawa (2017) were
21 presented with the same sentences that described a target person (e.g., a 34-year-old male
22 lawyer in Tokyo), and they inferred the mental state of the target (i.e., emotion, intention,
23 and motivation) based on the sentences. Projection degree scores (i.e., a standard beta
24 weight of ratings about the mental states of participants in regression analysis) were
25 equally high, despite the degree of perceived similarity to the target person. Following
26 Ames (2004a), we also measured the degree of stereotyping in mental state inferences
27 (i.e., a standard beta weight of ratings about mental states of a typical lawyer) and found
28 that the degree of projection was significantly high. This result supports the conjecture of
29 Study 3 that projection is more likely to be used when information about targets is scarce,
30 irrespective of the perceived similarity with the target person.

1 In other words, the results suggest is the existence of a boundary condition of the
2 similarity-projection hypothesis. In fact, some recent articles on social judgments have
3 reported the same line of evidence. For example, Farrar and Ostojic (2018) showed that
4 participants tend to over-extend their privileged information onto target others (i.e.,
5 egocentric bias) in a modified false belief task, and this effect was observed when the
6 target was perceived not only to be similar (a participants' in-group member) but also to
7 be dissimilar (an out-group member) to participants. As mentioned in Farrar and Ostojic
8 (2018), this result suggests that egocentric bias extended beyond judgments about similar
9 others. In another study (Willard & Markman, 2017), participants were asked to make
10 judgments regarding the preference or habit of a target person using Tamir and Mitchell's
11 (2013) reaction time paradigm. The results of the analysis suggested that when the target
12 was similar to participants' significant other, the knowledge regarding the significant
13 other was used as an anchor in the judgments rather than self-knowledge. Thus, the
14 relevance of knowledge to social judgments can be another determinant for people's use
15 of projection. Although the perceived similarity is an essential trigger for projection in
16 social judgments, these evidences, in addition to our result in study 3, strongly suggest
17 that it is necessary to reconsider the conditions under which people project their own
18 mental states onto others.

19 In summary, numerous studies have shown that people project their mental states
20 onto another person they perceive to be similar to themselves in social inference (e.g.,
21 Ames, 2004a, b; Todd et al., 2016). Tamir and Mitchell (2013) demonstrated this
22 similarity-projection hypothesis with a novel reaction time paradigm. We conducted a
23 series of studies using the reaction time paradigm in which different types of task and
24 target person were employed. The results support the robustness of the reaction time
25 paradigm for testing the similarity-projection hypothesis. Simultaneously, we found
26 evidence for the intriguing yet not-explained order effect in the similarity-projection
27 hypothesis. We also found that the projection could be used for inferring the mental states
28 of dissimilar others when information about the target is scarce. Future research is
29 necessary to reveal the complete image of how people make mental state inferences.

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Table 1. Results of GLMM using the whole data set in Study 1

	<i>B</i>	<i>SE</i>	Lower <i>CI</i>	Upper <i>CI</i>	<i>z</i>	<i>p</i>	Odds Ratio
(Intercept)	-0.86	0.16	-1.16	-0.55	-5.53	<.001	0.42
Reaction Time	0.34	0.14	0.07	0.62	2.45	.014	1.41
Target Person (similar = 0, dissimilar = 1)	0.54	0.22	0.11	0.96	2.48	.013	1.71
Block Order (other-first = 0, self-first = 1)	0.40	0.19	0.02	0.77	2.06	.040	1.49
Reaction Time × Target Person	-0.24	0.21	-0.66	0.18	-1.11	.268	0.79
Reaction Time × Block Order	-0.43	0.16	-0.74	-0.12	-2.72	.007	0.65
Target Person × Block Order	-0.08	0.28	-0.63	0.48	-0.27	.789	0.93
Reaction Time × Target Person × Block Order	0.29	0.25	-0.20	0.77	1.16	.244	1.33
Other-first condition							
(Intercept)	-0.77	0.11	-0.99	-0.55	-6.88	<.001	0.46
Reaction Time	0.21	0.13	-0.04	0.46	1.65	.100	1.23
Target Person	0.48	0.17	0.16	0.80	2.91	.004	1.62
Reaction Time × Target Person	-0.14	0.20	-0.53	0.24	-0.73	.468	0.87
Self-first condition							
(Intercept)	-0.45	0.14	-0.72	-0.17	-3.14	.002	0.64
Reaction Time	-0.06	0.08	-0.21	0.10	-0.71	.479	0.95
Target Person	0.44	0.21	0.03	0.85	2.10	.036	1.55
Reaction Time × Target Person	0.02	0.12	-0.22	0.26	0.18	.857	1.02

Table 2. Results of GLMM in Similar/Dissimilar other condition in Study 1

	<i>B</i>	<i>SE</i>	Lower <i>CI</i>	Upper <i>CI</i>	<i>z</i>	<i>p</i>	Odds Ratio
Similar other condition							
(Intercept)	-0.84	0.15	-1.14	-0.54	-5.54	<.001	0.43
Reaction Time	0.31	0.14	0.03	0.58	2.18	.029	1.36
Block Order	0.38	0.19	0.01	0.75	2.01	.044	1.47
Reaction Time $\times$ Block Order	-0.39	0.16	-0.70	-0.08	-2.45	.014	0.68
Other-first condition							
(Intercept)	-0.81	0.14	-1.08	-0.54	-5.87	<.001	0.44
Reaction Time	0.25	0.14	-0.03	0.53	1.74	.082	1.28
Self-first condition							
(Intercept)	-0.45	0.13	-0.71	-0.19	-3.36	.001	0.64
Reaction Time	-0.07	0.08	-0.22	0.09	-0.82	.411	0.94
Dissimilar other condition							
(Intercept)	-0.33	0.17	-0.67	0.00	-1.97	.049	0.72
Reaction Time	0.12	0.17	-0.21	0.45	0.73	.464	1.13
Block Order	0.34	0.21	-0.08	0.75	1.60	.111	1.40
Reaction Time $\times$ Block Order	-0.15	0.19	-0.52	0.23	-0.76	.446	0.86

Table 3. Results of GLMM using the data set in Study 2

	<i>B</i>	<i>SE</i>	Lower <i>CI</i>	Upper <i>CI</i>	<i>z</i>	<i>p</i>	Odds Ratio
(Intercept)	-0.83	0.14	-1.10	-0.56	-5.95	<.001	0.44
Reaction Time	0.38	0.15	0.09	0.67	2.59	.010	1.46
Target Person (similar = 0, dissimilar = 1)	0.81	0.15	0.51	1.10	5.38	<.001	2.25
Block Order (other-first = 0, self-first = 1)	0.34	0.21	-0.06	0.75	1.65	.099	1.41
Reaction Time × Target Person	-0.55	0.19	-0.92	-0.18	-2.91	.004	0.58
Reaction Time × Block Order	-0.69	0.19	-1.06	-0.32	-3.66	<.001	0.50
Target Person × Block Order	-0.58	0.23	-1.04	-0.12	-2.49	.013	0.56
Reaction Time × Target Person × Block Order	0.97	0.24	0.50	1.44	4.02	<.001	2.63

Table 4. Results of GLMM in Similar/Dissimilar other conditions in Study 2

	<i>B</i>	<i>SE</i>	Lower <i>CI</i>	Upper <i>CI</i>	<i>z</i>	<i>p</i>	Odds Ratio
Similar other condition							
(Intercept)	-0.88	0.17	-1.22	-0.54	-5.08	<.001	0.41
Reaction Time	0.46	0.16	0.13	0.78	2.78	.006	1.58
Block Order	0.38	0.26	-0.12	0.88	1.48	.139	1.46
Reaction Time $\times$ Block Order	-0.77	0.21	-1.18	-0.35	-3.65	<.001	0.46
Other-first condition							
(Intercept)	-0.90	0.19	-1.28	-0.52	-4.62	<.001	0.41
Reaction Time	0.50	0.17	0.17	0.84	2.94	.003	1.65
Self-first condition							
(Intercept)	-0.46	0.15	-0.77	-0.16	-3.00	.003	0.63
Reaction Time	-0.30	0.12	-0.54	-0.07	-2.54	.011	0.74
Dissimilar other condition							
(Intercept)	-0.02	0.13	-0.29	0.24	-0.17	.863	0.98
Reaction Time	-0.19	0.14	-0.47	0.09	-1.34	.179	0.83
Block Order	-0.25	0.19	-0.62	0.11	-1.35	.177	0.78
Reaction Time $\times$ Block Order	0.28	0.17	-0.06	0.62	1.61	.107	1.32

Table 5. Results of GLMM using the data set in Study 3

	<i>B</i>	<i>SE</i>	Lower <i>CI</i>	Upper <i>CI</i>	<i>z</i>	<i>p</i>	Odds Ratio
(Intercept)	-0.78	0.10	-0.99	-0.57	-7.43	<.001	0.46
Reaction Time	0.27	0.08	0.12	0.43	3.45	.001	1.31
Perceived Similarity	-0.24	0.07	-0.37	-0.11	-3.58	<.001	0.79
Block Order (other-first = 0, self-first = 1)	0.47	0.13	0.21	0.73	3.53	<.001	1.59
Reaction Time × Perceived Similarity	0.01	0.06	-0.11	0.13	0.19	.848	1.01
Reaction Time × Block Order	-0.11	0.10	-0.31	0.09	-1.07	.286	0.90
Perceived Similarity × Block Order	0.10	0.09	-0.08	0.28	1.08	.282	1.10
Reaction Time × Perceived Similarity × Block Order	0.04	0.07	-0.10	0.19	0.57	.571	1.04

Table 6. Results of GLMM when perceived similarity is high (+1 *SD*) and low (−1 *SD*) in Study 3

	<i>B</i>	<i>SE</i>	Lower <i>CI</i>	Upper <i>CI</i>	<i>z</i>	<i>p</i>	Odds Ratio
High Similarity							
(Intercept)	-1.07	0.13	-1.32	-0.82	-8.37	<.001	0.34
Reaction Time	0.25	0.11	0.03	0.47	2.27	.023	1.29
Perceived Similarity	-0.23	0.06	-0.36	-0.11	-3.61	<.001	0.79
Block Order (other-first = 0, self-first = 1)	0.58	0.18	0.22	0.93	3.17	.002	1.78
Reaction Time × Perceived Similarity	0.02	0.06	-0.10	0.13	0.29	.772	1.02
Reaction Time × Block Order	-0.02	0.14	-0.30	0.26	-0.15	.880	0.98
Perceived Similarity × Block Order	0.10	0.09	-0.07	0.28	1.14	.253	1.11
Reaction Time × Perceived Similarity × Block Order	0.04	0.07	-0.10	0.19	0.59	.557	1.04
Low similarity							
(Intercept)	-0.42	0.12	-0.66	-0.18	-3.42	.001	0.66
Reaction Time	0.21	0.11	-0.02	0.43	1.82	.069	1.23
Perceived Similarity	-0.23	0.06	-0.36	-0.11	-3.61	<.001	0.79
Block Order (other-first = 0, self-first = 1)	0.29	0.18	-0.05	0.64	1.67	.095	1.34
Reaction Time × Perceived Similarity	0.02	0.06	-0.10	0.13	0.29	.772	1.02
Reaction Time × Block Order	-0.14	0.14	-0.42	0.13	-1.00	.316	0.87
Perceived Similarity × Block Order	0.10	0.09	-0.07	0.28	1.14	.253	1.11
Reaction Time × Perceived Similarity × Block Order	0.04	0.07	-0.10	0.19	0.59	.557	1.04