What are my friends really like? How we change our perceptions of familiar others' traits and actions

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Abstract:

In everyday life, our pre-existing relationships influence our perceptions of others' traits and actions. We enrolled 142 participants in a virtual escape room to examine a) whether a novel challenge changed perceptions of friends' traits, b) how prior relationships influenced trait perceptions, and c) how prior relationships biased perceptions of behavior. Perceptions of competence were influenced by pre-game similarity, while perceptions of trait-level sociability were influenced by pre-game liking. Both effects were mediated by biased perceptions of game performance. Our findings demonstrate the importance of real-world relationships not only for how we change our beliefs about others' traits, but also their importance for perceptions of the very actions we use as evidence for those beliefs.

Keywords: Impression Formation, Person Perception, Social Cognition, Social Interaction, Multilevel Modeling

In everyday life, we face numerous novel situations in which we work with friends and coworkers to overcome stressful challenges and achieve common goals. An important question is what we learn from such novel situations about the traits of well-known others. For example, if we observe that a friend or coworker that we previously thought to be competent or sociable did not exemplify those traits in a new situation, then we may change how we interact with and rely on that person in the future. Addressing this question is clearly important, as highlighted by evolutionary theories that suggest that learning to coordinate with kin was an essential driver of the development of human social intelligence (Hayes & Sanford, 2014; Tomasello et al., 2012).

Surprisingly however, experimental behavioral work has left this question largely unexplored, as the two most relevant social psychological research literatures – person perception and relationships – tend to operate independently and seldom connect. On the one hand, person perception research typically examines perceptions of and/or interactions with novel (or hypothetical) people (Brannon & Gawronski, 2017; Fiske, 1993). As such, this work cannot tell us how pre-existing relationships, and the factors that define them (i.e., relational factors, such as liking, familiarity, and perceived similarity), influence perceptions of others. Conversely, work on pre-existing relationships typically asks about relationship formation, satisfaction and longevity (Finkel et al., 2017; Lemay & Clark, 2015), rather than asking about how trait perceptions of close others change in light of new information. As such, the question of how we change our perceptions of a friend's traits after interacting in a novel context has received relatively little attention.

Here, we seek to address these issues by asking how our perceptions of friends may change when working with them to face novel and stressful challenges. Specifically, we apply classic questions about person perception, which typically ask how we perceive novel or hypothetical people, to real pre-existing relationships, which are not typically studied in the context of trait perceptions. Although these lines of research are not commonly brought together in this way, we drew on previous person perception research to formulate the three inter-related questions that we sought to address in this study.

First we asked whether working with well-known others in a novel environment might alter our perceptions of two well-studied traits that are likely to be relevant when individuals work in groups towards a common goal: competence and sociability (Brambilla et al., 2021; Castelli et al., 2009; Landy et al., 2016). Competence broadly refers to one's ability to accomplish goals (Abele & Wojciszke, 2014; Fiske et al., 2007). Sociability is often associated with traits like extraversion and friendliness, but broadly describes how well someone can attract social support or social attention (Brambilla et al., 2011; Goodwin et al., 2014). Some person perception work with unfamiliar or hypothetical targets suggests that interpersonal beliefs can be change-resistant (Cao & Banaji, 2016; Ferguson et al., 2019). In addition, we may be less likely to change our perceptions about well-known others' traits due to the large amount of evidence we already have about them (Kim et al., 2020). However, a novel environment that requires the use of those traits in unexpected ways may create opportunities to change our perceptions of well-known others.

Second, we asked how our relationship to a target may influence the way we make trait attributions about them (Brambilla et al., 2011, 2019; Goodwin et al., 2014; Landy et al., 2016). For people we know well, we reasoned that at least three factors related to one's associations with, and relationship to, a target person could be important (Fiske, 1993; Kenny, 2004; Klein & Kunda, 1992; Zaki, 2014). The first is our liking of a target (Jussim et al., 1995; Leising et al., 2013; Wessels et al., 2020), which may motivate us to perceive them more favorably, thereby

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allowing us to maintain a view of ourselves as someone who has good judgment and likes others with positive traits. In the group problem solving example, when someone we like acts in a way that could exemplify a positive trait – such as sociability – we may be motivated to perceive them as possessing that trait more strongly than we would for someone we liked less. A second factor is familiarity (Montoya et al., 2017; Saegert et al., 1973; Zajonc, 1968), which tends to promote liking, in general (Reis et al., 2011; Zajonc, 2001). Psychology has long documented our fear of the unknown and preference for the familiar, so it's possible that we are more likely to positively assess those we know well and negatively assess those we don't know as well. Finally, a third important factor is perceived similarity to oneself (Alves et al., 2016; Ames, 2004; Moreland & Zajonc, 1982; Mussweiler, 2003). Work on self-enhancement suggests that we view ourselves as better and/or more important than we actually are (Beer & Hughes, 2010; Sedikides & Gregg, 2008), and it is possible that these enhancement effects might more easily extend to people we consider to be similar, rather than dissimilar, to ourselves.

Taken together, these considerations sharpened our second question, which specifically asked: how do all three of these relational factors – liking, familiarity, and perceived similarity – shape perceptions of a target's trait-level competence and sociability? These three relational factors are commonly studied in relation to each other in person-perception research (Alves et al., 2016; Moreland & Zajonc, 1982; Strauss et al., 2001), but how they interact to affect perceptions of friends' traits is unclear. In that context, there are two types of effects we may observe. On the one hand, we may see a global effect, in which all three relational factors influence trait perceptions. This scenario would suggest that changes in perceptions of close others' traits are affected by merely the existence of a prior relationship, rather than the relationship's specific qualities. On the other hand, we may see a more selective effect, where some relational factors matter more than others. In this case, we would conclude that we value specific aspects of our relationships when re-assessing close others' traits.

Our third question asked how our perceptions of a target's competence and sociability relate to the target's actions, as well as our perceptions of their actions. Even when person perception studies do ask about close others, they rarely attempt to link perceptions of traits to perceptions of actions. To the extent that relational factors impact global trait perceptions, it's possible that these same relational factors might also impact perceptions of actions while working to achieve those goals. For example, when working with others to solve a problem, individuals more adept at completing a task may be described as more competent, whereas people who collaborate better with others may be perceived as more sociable. However, our *perceptions* of these proximal behaviors may ultimately provide the impetus for making trait judgments. As such, we sought to test a) whether a target's objectively quantifiable actions during a group problem-solving task would impact perceptions of their traits, and b) whether relational factors would influence perceptions of these actions, which may in-turn impact perceptions of traits. If perceptions of both in-the-moment actions and global traits are biased according to relational factors, it would suggest that we use biased evidence that subsequently informs biased global trait perceptions of close others. If, on the other hand, perceptions of global traits are biased but perceptions of actions are unaffected by relational factors, it would suggest that we ignore close others' recent specific actions when re-assessing their traits

To address these three questions, we collected data from friends completing a virtual escape room game because it provided a novel and motivating environment that required people to work together to achieve a common goal. In addition, this activity allowed participants to freely interact with each other in a structured context with concrete performance metrics.

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Critically, the two traits of interest here – competence and sociability – are directly relevant to this type of activity. Competence is demonstrated by one's ability to find clues, solve puzzles, and ultimately "escape" a virtual room. Sociability is demonstrated by one's ability to coordinate with team members to solve puzzles that often require teamwork and communication.

Methods

All analysis scripts can be found on the study's github page. Model output for analyses, as well as the full surveys administered to participants, with all measures, can be found on the study's OSF page. All study procedures and data collection were performed in accordance and with the approval of the Columbia Institutional Review Board.[1]

Participants

142 participants were recruited, across 30 groups of 3-5 friends (96 F; mean age: 25.8; age range: 18-66). Two groups were excluded from analyses involving the video recording due to technical errors saving the video, leaving 132 participants for those analyses. No other participants were excluded. Participants were recruited through online advertisements, email lists, and word of mouth and completed informed consent before starting the first survey.

Procedures

One week before the group's scheduled escape room game, each group member was sent a series of questionnaires on the Qualtrics survey platform. In addition to basic demographics, participants provided comprehensive evaluations about themselves and each group member, including their perceptions of their competence and sociability, as well as levels of familiarity, liking, and similarity (see "Definition of variables" section for how each variable was calculated). One week after receiving the questionnaires, the group participated in their virtual escape room game over Zoom. (See more information about the escape room experience in the following section.) All escape room games were recorded. Upon immediate completion of the escape room game, participants completed another series of questionnaires. They provided identical evaluations about each teammate, and also answered questions about the escape room experience. They also indicated how well they believed each teammate did in terms of solving puzzles and collaborating with teammates. See *Figure 1* for a schematic of the study design.

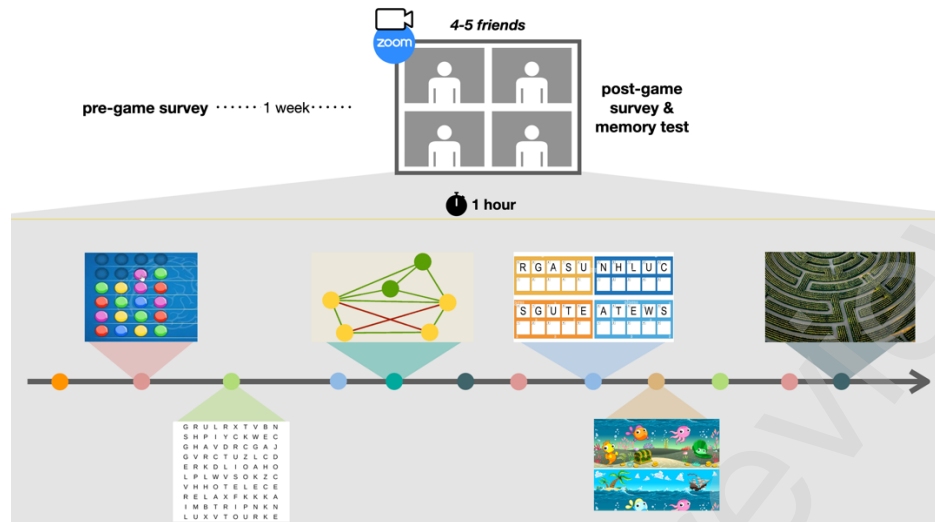[1] This study was not preregistered.

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Figure 1. Experimental design. Participants first completed a pre-game survey to assess levels of similarity, liking, and familiarity between teammates, as well as perceptions of competence and sociability. The escape room was conducted on Zoom and required participants to work together to complete a series of puzzles. Immediately after the game, participants completed a post-game survey about their game experience, as well as updated perceptions of competence and sociability.

Escape Room game

The COVID-19 pandemic presented a unique opportunity to conduct our study, in which meaningful social interactions largely occurred online, where they could easily be recorded. In addition, many social activities that would typically be difficult or impossible to use as controlled experimental paradigms were translated to a more controlled, virtual space.

The virtual escape room game that we used in our study was created and administered by an escape room company called Puzzle Break LLC. The particular virtual escape room that all participants in this study completed was called Hackfiltration. The goal of Hackfiltration is to solve a series of puzzles in order to hack into a company's computer system and prevent them from enacting world domination. The escape room was completed online and over Zoom. Each group completed the escape room game with the guidance of a "game manager," a Puzzle Break employee who explained the rules of the game to the participants and was available to provide hints to the group if needed. Completing the escape room required the participants to work together to find clues, solve logic puzzles, and follow a storyline across several different websites, videos, and virtual games. Typically, one group member would share their screen, and the other group members would follow along. Group members were free to speak to each other and interact as much as they wanted. Upon completion of the game, the game manager walked the group through the game solution. On average, groups took 48.9 minutes to complete the game, with completion times ranging from 26.2 minutes to 87.6 minutes. If a team was struggling to complete the game, the game manager would provide progressively helpful hints in order to move the team along and ensure that all groups completed the entire game.

Definition of variables

Our primary predictor variables were liking, familiarity, and perceived similarity for each group member, as measured before the escape room game. Liking and similarity were assessed

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with single questions ("How much do you like this person?" "How similar do you believe you are to this person?") on a 0-10 scale, while familiarity was calculated as the product of the length of time the participant had known the target, and the frequency of interactions with them (scale of 1-36).

Trait-level competence and sociability perceptions for each group member were also measured via survey questions, both before and after the escape room game. Each trait perception was defined as the average of four questions that indexed different components of each trait (Goodwin et al., 2014), as measured on a 0-10 scale. For competence, the questions were: 1) "[Group member] is able to succeed when faced with challenging situations." 2) "[Group member] is able to solve difficult problems." 3) "[Group member] is good at getting what they want." 4) "[Group member] is good at adapting to unfamiliar situations." For sociability, the questions were: 1) "[Group member] works well with other people." 2) "[Group member] is quick to understand the experiences and feelings of others." 3) "[Group member] doesn't act like they are better than other people." 4) "[Group member] is generous and considerate of others."

We also created two different measures of performance during the escape room to map onto our two traits of interest: Puzzle solving, which we hypothesized would be related to trait-level ratings of competence, and team collaboration, which we hypothesized would be related to trait-level ratings of sociability.

Both measures of performance were calculated using the Zoom recordings of the escape room game. For puzzle solving performance, the escape room game was broken into 50 steps. These steps were highly specific occurrences that nearly every team needed to experience in order to complete the escape room. Each step was time-stamped, and "attributed" to a specific participant, based on which participant verbally contributed the most crucial information to complete that step, as determined by an independent coder. For example, one of the steps was figuring out the password to log into a computer system. At the exact moment that a participant indicated they knew what the password was, the time was recorded and that participant was marked as contributing to that step. If multiple participants contributed to the same step – say, by saying the answer at the same time – they split the point. Once the video was fully coded, each participant received a puzzle solving performance score, according to how many steps they contributed over the course of the entire game.

For team collaboration performance, we ran a linguistic analysis of the transcripts from the Zoom recordings. For each participant, we calculated a team collaboration performance score, which was the number of times they used words that focused on the group – first-person plural and second-person pronouns – over the number of total words spoken by the entire group, similar to previous approaches (Lyons et al., 2018; Pennebaker & Chung, 2013; Sillars et al., 1997). By creating a percentage that relied on both the individual contributions and the total group contributions, we are able to standardize team collaboration performance scores within each group, while also taking into account how much that participant spoke.

Analyses

To address our three questions, we constructed a series of Bayesian multi-level models. Each analysis consisted of two separate models: one for competence, and one for sociability. For all models, participant was the grouping variable, and each rating of a teammate was a repeated measure. Although the participants completed the escape room in discrete groups, our questions primarily concerned evaluations and perceptions at the *interpersonal* level, rather than the group

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level. The groups were merely a mechanism to enroll participants, rather than a relevant component of our analyses. Thus, group-level social dynamics were not investigated in this study. All models had random slopes and intercepts for the predictor variables, which were mean-centered and scaled around 0.

Our first question was whether competence and sociability ratings after the game significantly differed from pre-game ratings. Specifically, our predictor variable was a Time variable consisting of pre-game ratings and post-game ratings. Our outcome variable was the trait rating. A post-hoc sensitivity analysis with this model using the *pwr* package in R (Champely, 2020) revealed that our sample size provided over 80% power to detect a medium-sized effect.

For our second question, we asked how liking, familiarity, and perceived similarity, as measured in a pre-escape room questionnaire, interacted to affect post-game ratings of competence or sociability. Importantly, these models controlled for pre-game ratings, ensuring that any change observed from the pre- to post-game ratings was a result of the escape room game specifically.

Our third question concerned performance during the game. We first ran a model that asked how objective puzzle solving performance (as measured from the Zoom recordings in the ways defined in the previous section) interacted with relational factors to affect post-game trait-level competence perceptions. We then ran an identical model that asked how objective team collaboration performance interacted with relational factors to affect post-game trait-level sociability perceptions.

We then asked whether subjective perceptions of performance mediated the relationship between relational factors and trait perceptions. We call this subjective perception of performance a Performance Assessment Bias (PAB). PAB scores were calculated by subtracting the *objective* puzzle solving and team collaboration scores – as calculated in the manner described in the previous section – from *subjective* puzzle solving and team collaboration scores, as determined by participant ratings of teammates on the post-game questionnaire. Thus, we created one PAB score for puzzle solving, and a separate PAB score for team collaboration. To answer our mediation question, we first ran models that asked how the same three relational factors affected PAB scores. We then ran added PAB scores as a predictor to our relational factors models from question two to see if a) PAB scores predicted trait perceptions, and if b) the presence of this effect decreased the direct effect of relational factors on trait perceptions.

Results
Question 1: Does a novel and challenging group activity lead to altered perceptions of friends' traits?

For all results, we discuss effects on competence first, followed by effects on sociability. Using Bayesian multi-level models, we examined whether post-game ratings of competence and sociability were significantly different from pre-game ratings. When comparing ratings before the escape room game to ratings immediately after the game, we found that the escape room game overall led to enhanced perceptions of both competence (B = 0.48, SE = 0.07, 95% CI = [0.34, 0.63]) and sociability (B = 0.38, SE = 0.08, 95% CI = [0.23, 0.54]) (*Figure 2A, B*).
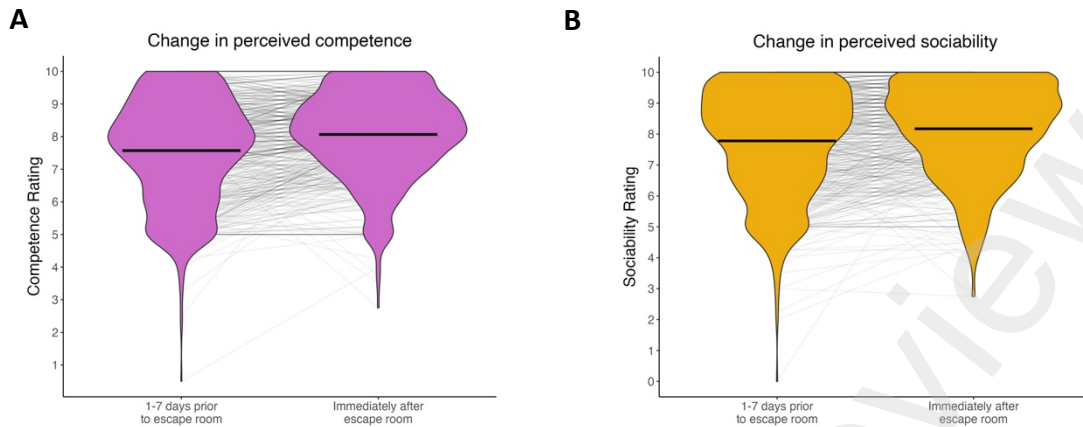
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Figure 2. Competence (A) and sociability (B) ratings increased immediately after the escape room game, as compared to before it.

Question 2: How are perceptions of a friend's traits influenced by aspects of our relationship to them (i.e., relational factors)?

Given the increases in competence and sociability, we next wanted to investigate how relational factors between the perceiver and the target prior to the game – liking, familiarity, and similarity – would affect the degree of change in competence and sociability ratings immediately after the game. All models controlled for pre-game ratings of competence and sociability.

When examining how relational factors affected post-game competence, we found a significant effect of similarity (B = 0.16, SE = 0.07, 95% CI = [0.02, 0.30]), where participants rated targets that they viewed as more similar to themselves as more competent. There was no effect of liking (B = 0.11, SE = 0.08, 95% CI = [-0.05, 0.27]) or familiarity (B = 0.06, SE = 0.06, 95% CI = [-0.05, 0.18]) (*Figure 3A*).

When examining perceptions of trait-level sociability, we found that liking was the most important relational factor (B = 0.23, SE = 0.09, 95% CI = [0.05, 0.40], with more well-liked targets perceived as more globally sociable after completing the escape room game. There was also a trending effect of familiarity (B = 0.10, SE = 0.06, 95% CI = [-0.03, 0.22]), and no effect of similarity (B = -0.03, SE = 0.06, 95% CI = [-0.15, 0.10]) (*Figure 3B*).
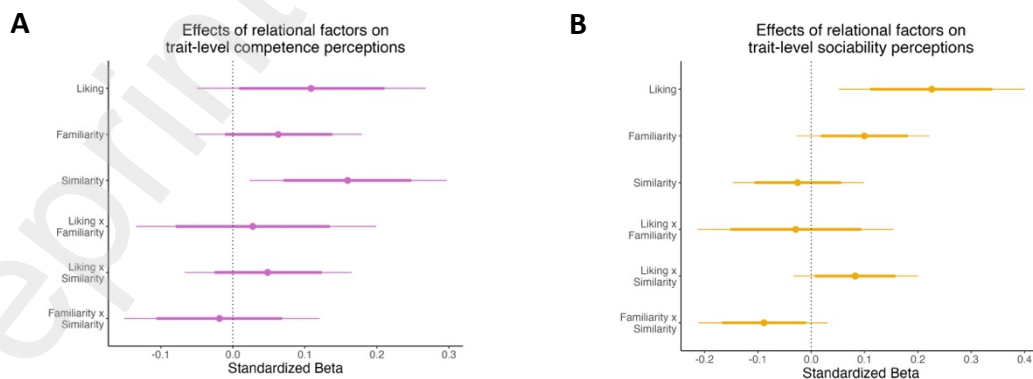

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Figure 3. Effects of relational factors on perceptions of teammates' trait-level competence (A) and sociability (B). Thick bars are 80% credibility intervals, thin bars are 95% credibility intervals.

Question 3: How do a friend's actions affect perceptions of their traits?

A friend's actions may affect how we perceive their traits in at least two different ways. First, their *objective* actions – in this case, how they actually performed during the escape room – might have an effect on global trait perceptions, both on its own and in interaction with relational factors. To answer this question, we ran a model with relational factors and escape room game performance as our predictor variables, and post-game trait ratings as our outcome variable. Second, biased perceptions of actions might also be impacted by relational factors, and in turn might mediate the above relationship between relational factors and global trait perceptions. We operationalized this bias, which we call the Performance Assessment Bias, or PAB, as the difference between the subjective rating of a friend's performance during the escape room via a questionnaire, and an objective score for their performance as determined from a Zoom recording or transcript. To answer this question, we first ran a model with our three relational factors as predictor variables, and PAB score as the outcome variable. We then ran a model with the relational factors and PAB score as predictor variables and post-game trait ratings as the outcome variable to determine whether PAB was acting as a mediator.

Effect of objective performance on trait perception: When considering how perceived global competence was predicted by puzzle solving performance during the escape room (specifically, the number of steps for which each participant contributed solutions), we found a main effect of puzzle solving (B = 0.22, SE = 0.04, 95% CI = [0.14, 0.31]), as well as a trending interaction between puzzle solving and similarity (B = -0.08, SE = 0.06, 95% CI = [-0.20, 0.03]) (*Figure 4*). Specifically, the interaction revealed that the effect of similarity on competence ratings was stronger for people worse at puzzle solving. In addition, participants did not distinguish competence ratings based on performance for the most highly similar teammates. The interactions between puzzle solving and liking (B = -0.06, SE = 0.06, 95% CI = [-0.19, 0.06]) and between puzzle solving and familiarity (B = -0.01, SE = 0.06, 95% CI = [-0.12, 0.11]) were not significant.

We defined team collaboration performance during the escape room game as the frequency of group-focused words (first-person plural and second-person pronouns) over total words spoken by all members of the group. When considering the effects of team collaboration performance on perceived global sociability, we found no effects of collaboration alone on trait-level sociability ratings (B = -0.04, SE = 0.05, 95% CI = [-0.13, 0.05]). In other words, the amount that participants used group-focused language during the escape room did not impact global beliefs about that participant's sociability. We also did not find any significant interactions between relational factors and team collaboration (liking: B = -0.09, SE = 0.09, 95% CI = [-0.27, 0.09]; familiarity: B = 0.06, SE = 0.07, 95% CI = [-0.07, 0.19]; similarity: B = -0.02, SE = 0.08, 95% CI = [-0.17, 0.13]). However, the trend of the interaction between liking and team collaboration performance was structurally similar to the similarity by puzzle solving performance interaction for competence ratings: Liking impacted sociability ratings more for targets who didn't perform well in team collaboration than for targets who did perform well. More well-liked targets were treated as equally sociable, regardless of their team collaboration performance.
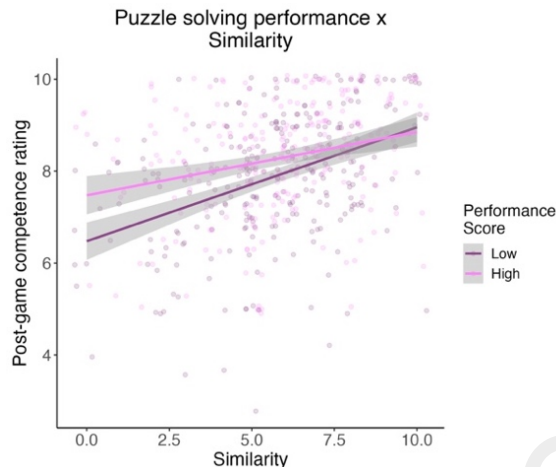
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Figure 4. Interaction between perceived similarity and puzzle solving performance on competence perceptions. Low vs high performance is a median split. The ribbons around the regression line represent 95% credibility intervals.

Mediation analysis, Part 1: After determining that both relational factors and performance impact perceptions of trait-level competence and sociability, we next asked whether biased perceptions of the target's actions – the PAB, as defined in Methods – mediated the relationship between relational factors and trait perceptions.

The participant's *objective* performance scores were rescaled to a range of 0-10 to align with the range of the *subjective* performance questions. Since the PAB was the difference between these two scores, a positive score indicated that participants reported their teammates as having performed better than they actually did, while a negative score indicated that participants reported teammates as having performed worse than they actually did. There were two PAB scores: One that was related to how well the participant did on solving puzzles, which we hypothesized would impact perceptions of trait-level competence, and one that was related to how well the participant collaborated with members of the team, which we hypothesized would impact perceptions of trait-level sociability.

We ran two models with the same three relational factors – liking, familiarity, and similarity – as predictor variables and each PAB score as an outcome variable. With a positive intercept of 5.27, we found that similarity trended towards predicting puzzle solving PAB scores (B = 0.21, SE = 0.13, 95% CI = [-0.05, 0.47]). This result implies that participants were *more* positively biased in their perception of their teammates' ability to solve puzzles during the escape room game for those they were more similar to (*Figure5A*). Liking (B = 0.13, SE = 0.15, 95% CI = [-0.19, 0.42]) and familiarity (B = 0.14, SE = 0.12, 95% CI = [-0.09, 0.37]) were not significant predictors of puzzle solving PAB and had far smaller effect sizes than similarity.

For team collaboration PAB, we saw a similar pattern of results, but with liking implicated instead of similarity. A model with liking, familiarity, and similarity as the predictor variables and team collaboration PAB as the outcome variable revealed a positive intercept of 6.10 and a trending effect of liking (B = 0.28, SE = 0.17, 95% CI = [-0.06, 0.61]) and familiarity (B = 0.24, SE = 0.13, 95% CI = [-0.02, 0.49]). The more a participant liked a teammate, or the more familiar they were, the *more* positively biased the participant was in their state-level

perception of the teammate's collaboration during the game (*Figure 5B*). There was no significant effect of similarity (B = -0.16, SE = 0.14, 95% CI = [-0.44, 0.12]).
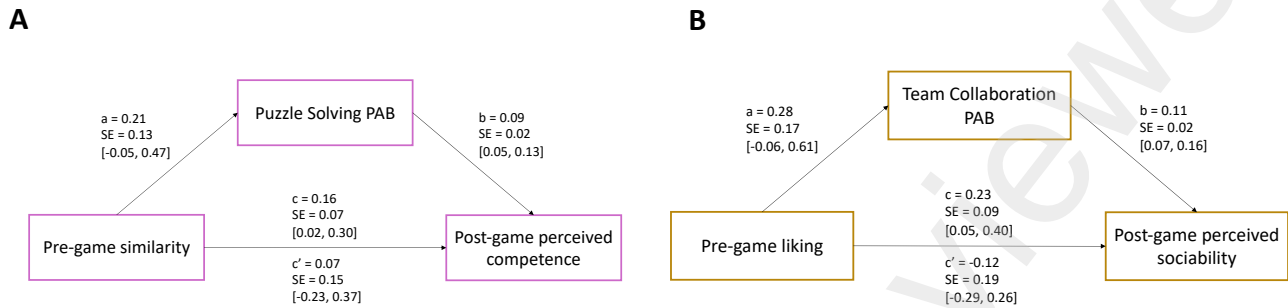
A

B

Figure 5. Performance Assessment Bias (PAB) is the difference between perceived performance as reported by teammate ratings and actual performance as determined by video recording. For competence, performance is defined as ability to solve puzzles. Puzzle solving PAB scores mediate the relationship between similarity and competence perception (A). For sociability, performance is defined as ability to collaborate with the team. Team collaboration PAB scores mediate the relationship between liking and sociability perception (B).

Mediation analysis, Part 2: We followed up these results with an additional Bayesian multi-level model that included all three relational factors *and* the relevant PAB as fixed and random effects in order to determine if the PAB score mediated the relationship between the relational factors and trait perceptions. We found that PAB did indeed mediate the effect, for both competence (B = 0.09, SE = 0.02, 95% CI = [0.05, 0.13]) (*Figure 5A*) and sociability (B = 0.11, SE = 0.02, 95% CI = [0.07, 0.16]) (*Figure 5B*). In both models, PAB significantly predicted trait perceptions, and the direct effect (similarity for competence, liking for sociability) disappeared (Competence: B = 0.07, SE = 0.15, 95% CI = [-0.23, 0.37]; Sociability: B = -0.12, SE = 0.19, 95% CI = [-0.49, 0.26]). This result suggests that relational factors bias perceptions of others' in-the-moment actions, which then in turn are used to create biased perceptions of others' global traits.

Discussion

In this study we investigated how one's prior relationship to a target – in terms of liking, familiarity, and perceived similarity – impacted perceptions of friends' traits and actions as they worked together to overcome a shared problem. Previous research in this area has not been able to adequately address this question because person perception work traditionally focuses on initial trait perceptions in novel targets, while close relationships work does not typically ask about changing trait perceptions. We used a virtual escape room game conducted on Zoom as our paradigm to allow participants to freely interact and solve puzzles for approximately one hour in a novel environment. Four key findings were obtained.

First, we found that ratings of friends' trait-level competence and sociability increased as a result of a novel experience – in this case, the escape room game. Second, we found that pre-existing relationships *selectively*, rather than globally, impacted trait perceptions. For competence, we found that higher baseline similarity led to higher post-game competence ratings, and for sociability, we found that higher baseline liking led to higher post-game

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sociability ratings. Third, we found that a target's objectively assessed actions interacted with relational factors to impact trait perceptions. Specifically, participants only incorporated teammate performance into their competence perceptions for less similar teammates. Highly similar teammates were viewed as equally competent regardless of their performance. Fourth, we also found that biased perceptions of performance mediated the relationship between relational factors and trait perceptions, suggesting that relational factors bias perceptions of actions, which then in turn are used to create biased perceptions of traits. Below, we unpack each of these findings.

Changes in perceptions of trait competence and sociability

First, we saw that both competence and sociability ratings increased overall as a result of the escape room game. Previous work has shown a positivity bias for competence (Reeder et al., 1977; Wojciszke et al., 1993), in that it's easier to update competence beliefs in the positive direction than the negative direction. Our study is to our knowledge the first to demonstrate a parallel effect in the sociability dimension, since sociability is typically lumped in with morality in studies of impression updating. It has been hypothesized that the reason for this asymmetry is that competent actions are more "diagnostic" than incompetent ones (Mende-Siedlecki et al., 2013).

How relationships impact trait perceptions

For both competence and sociability, specific components of one's prior relationship with a target impacted perceptions of that target's traits after working together to solve a novel challenge. What the competence and sociability findings share is an emphasis on prior relationships, which motivate our perceptions. Even for those we know well, relative degrees of motivation continue to impact our assessments of others. This is in line with previous work that goes above and beyond investigating changes in impressions for strangers, and instead uses in-group members and close friends (Hughes et al., 2017; Park & Young, 2020). However, even this work is still comparing friends to strangers, or an ingroup to an outgroup. Our study demonstrates that within a close group, our beliefs are biased about some friends more than others.

Where the competence and sociability findings differ, however, is in the type of relational factor that matters. When controlling for baseline (i.e., pre-game) ratings of competence and sociability, we found that higher perceived similarity led to higher post-game competence ratings, and higher liking led to higher post-game sociability ratings. Let's take a moment to consider each of these findings in turn.

This similarity-competence connection may be related to the self-enhancement effect. Long documented in psychology (Alicke & Sedikides, 2009; Sedikides & Gregg, 2007, 2008), self-enhancement theories posit that we have a motivation to view ourselves positively or favorably. Given that competence is a desired quality for oneself (Anderson et al., 2012; Heck & Krueger, 2016), it makes sense that we would be motivated to perceive people who are more similar to us as also more competent. The liking-sociability connection, on the other hand, may be because sociability signifies a person's ability to maintain a successful relationship. If we like someone, we'll want to maintain a successful relationship with them, which would motivate us to view them as more sociable. Sociability is also a trait more desired in others than the self (similar to morality (Wojciszke, 2005)), although there is limited work in this area (Soral & Kofta, 2020). These results demonstrate a separability between the desired qualities in oneself and the desired

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qualities of others (Brambilla & Leach, 2014; Wojciszke, 2005), and extend previous work into the sociability domain.

How actions and action perceptions relate to trait perceptions

        Our perceptions of others' traits are often based on their actions, in addition to our relationship with them, and it is possible that biased perceptions of actions may lead to biased perceptions of traits. We found that puzzle solving performance was only important for forming trait-level perceptions of competence for teammates lower in similarity. Highly similar teammates who didn't perform well were perceived to be just as competent as highly similar teammates who did perform well. The interaction between team collaboration performance and liking, and its effect on sociability, was non-significant but structurally analogous.

        One possible interpretation of these results is that when we have a positive relationship with someone, we down-weight their most recent actions when asked to assess their traits. In this context, positive pre-existing relationships with teammates caused participants to perceive low-performing teammates as just as competent or sociable as high-performing teammates. This interpretation would be in line with previous work that suggests that we ignore or discount others' actions if they are incompatible with our trait-level perceptions (Howard & Rothbart, 1980; Lemay & Clark, 2015).

        However, this interpretation is complicated by the fact that, for both competence and sociability, the relational factor that best predicted subsequent beliefs (similarity for competence, liking for sociability) also predicted biased perceptions of the target's actions during the game. Targets higher in similarity were perceived as better at solving puzzles, and targets higher in liking were perceived as better at team collaboration. It's possible that this finding can be explained by state-trait models of person perception. State-trait models distinguish between qualities a person is deemed to possess generally and qualities they display in a particular situation (Hamaker et al., 2007; Trope, 1998). Judgments of each can converge or diverge depending on the context (Gilbert et al., 1988; Kruse & Degner, 2021). In the current study, participants are motivated to perceive their teammates as competent and sociable both within the specific context of the escape room (a state) and more broadly (a trait).

        But we didn't just find that ratings of performance are predicted by relational factors. Specifically, we find that relational factors predicted the *difference* between ratings of performance and objective performance. We term this difference a Performance Assessment Bias (PAB). The effects of similarity and liking on the PAB suggest that similarity and liking actually alter the way people perceive and/or remember their teammates' actions, in addition to simply altering trait-based assessments. This distinction is important because it sheds light on the mechanisms by which motivations may indirectly shape perceptions of others' traits (Zaki, 2013). Indeed, a mediation analysis revealed that both PABs mediated the relationship between the relevant relational factor and the trait assessment. For competence, similarity biased perceptions of puzzle-solving performance during the game, which then led to altered trait-level competence perceptions. The story was similar for sociability: Liking biased perceptions of collaborative behavior during the game, which in turn led to altered perceptions of trait-level sociability. In both cases, biased trait perceptions were based on biased action perceptions, and relational factors determined the size of these perception biases.

Limitations and future directions

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The majority of the analyses in this paper concern the beliefs one person (the observer) holds about another person (the target). As dyadic interactions unfold across time, however, individuals may alternate between the target and observer roles. Future studies may wish to take this into account and ask how an observer's perceptions of a target impact the target's perceptions of the observer, and vice versa (Back & Kenny, 2010; Human et al., 2020). More broadly, the actions of any individual may be embedded within the actions of a larger group. In a complex and collaborative problem-solving environment (like an escape room game), we may wish to ask how group dynamics, such as the structure of the social network and the nature of social interactions between group members, impact group performance and group well-being. Organizational psychology has long investigated the factors that create successful groups in a workplace context (Cannon-Bowers & Bowers, 2011; Hesse et al., 2015; Mathieu et al., 2019; Neubert et al., 2015), but there has been comparatively little work in social psychology that seeks to understand how group dynamics dictate beliefs about specific others within that group, or how relationships between people and feelings towards others affect a group's ability to accomplish a goal. Finally, future studies may wish to utilize other types of events beyond a virtual escape room, and test other dimensions of person perception, such as morality, in order to determine how well our findings generalize across contexts.

When people work together to achieve a common goal, they draw conclusions about each other's traits based on how each person performed during their shared experience. In the present study, we showed that not only does a perceiver's prior relationship with a target impact perception of that target's traits, but also that the perceiver's prior relationship with the target biases perception of the target's in-the-moment actions. Those biased perceptions of actions may in turn mediate the relationship between relational factors and trait perceptions. When groups of friends completed a virtual escape room together, prior perceived similarity impacted perceptions of both trait-level competence and situational competence (ability to solve puzzles), while prior liking impacted perceptions of trait-level sociability and situational sociability (team collaboration). Our relationship with another person impacts nearly every aspect of how we perceive them. We're biased in our perceptions of their traits, but perhaps more importantly, we're also biased in our perceptions of their actions. It's these biased perceptions of individual actions that add up to global trait assessments inextricably tied to our relationships.

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