The Contextual Evolution of the Warmth-Competence Relationship in Intergroup Evaluation: The Role of Evaluation Intention and Outcome (Postprint)

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Abstract

Context influences social cognition; how does the relationship between the two dimensions of warmth and competence vary with context during intergroup evaluation? This study employs the "distant planet paradigm" to conduct a series of experimental investigations, examining—from both single-dimension and dual-dimension information presentation perspectives of warmth and competence—the effects of success and failure outcomes on perceptions of group warmth and competence under competitive and cooperative contexts. The results indicate: (1) In perceptions of outgroup warmth and competence, a positive relationship exists between the two when inferring competence from the warmth dimension, whereas a negative relationship exists when inferring warmth from the competence dimension. (2) The influence of evaluation intention on warmth and competence ratings of outgroup members is independent of specific context; when interaction intentions are known, people' s evaluations of outgroup members on both warmth and competence exhibit a regression-to-the-mean balancing trend. (3) The impact of success and failure outcomes on warmth and competence evaluations of outgroup members is constrained by context. In competitive contexts, warmth and competence display a trade-off inverse evolutionary trend, whereas in cooperative contexts, they show a concurrent rise and fall congruent evolutionary trend.

Full Text

Situational Evolution of the Warmth-Competence Relationship in Intergroup Evaluation: The Role of Evaluative Intentions and Outcomes

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Abstract

Situation influences social cognition. How does the relationship between warmth and competence—two critical dimensions in intergroup evaluation—evolve across different situations? This research employed a series of experimental studies using the "Distant Planetary Paradigm" to examine this question. Drawing on both single-dimension and dual-dimension information presentation perspectives of warmth and competence, we investigated how success and failure outcomes in competitive versus cooperative contexts affect perceptions of group warmth and competence. The results demonstrate: (1) In perceptions of outgroup warmth and competence, a positive relationship emerges when inferring competence from warmth, whereas a negative relationship appears when inferring warmth from competence. (2) The influence of evaluative intentions on warmth and competence ratings of outgroup members is independent of specific situational contexts. Upon learning of interaction intentions, people' s evaluations of outgroup members on both dimensions exhibit a "centralizing" or balancing tendency. (3) The impact of success/failure outcomes on warmth and competence evaluations is constrained by situational context. In competitive contexts, warmth and competence demonstrate an inverse evolutionary pattern of "one rising while the other falls," whereas in cooperative contexts, they show a parallel pattern of "rising and falling together."

Keywords: stereotype content; warmth; competence; situational evolution; success-failure; intergroup evaluation

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In human social life, intergroup evaluation plays a crucial role in mitigating intergroup conflict, prejudice, and discrimination, and has long been a focal topic in social psychology. However, researchers have rarely examined intergroup evaluation from a dynamic perspective of evolving social interaction contexts. Real-world intergroup evaluation is not a static process. As contexts change through intergroup contact, interaction, and feedback, intergroup evaluations undergo corresponding shifts (Vezzali, Turner, Capozza, & Trifiletti, 2018; Capozza, Bernardo, & Falvo, 2017). Grounded in the "Big Two" model of social cognition (Zuo, Dai, Wen, & Suo, 2015), the present research examines, for the first time, the psychological processes through which warmth and competence evaluations of outgroups evolve over time and across situations, adopting both single-dimension and dual-dimension perspectives on warmth and competence information presentation. On one hand, understanding intergroup relations from the perspective of contextual interaction evolution holds important ecological significance for real-world applications. On the other hand, it provides a novel intergroup evaluation perspective for deepening our understanding of the relationship between warmth and competence within the "Big Two" model.

Previous research has demonstrated that context significantly influences intergroup evaluation (Meeusen, Barlow, & Sibley, 2017). The situational interdependence of intergroup evaluation can be traced back to Sherif' s classic Robbers Cave experiment, in which 21 boys aged 11-12 were invited to a summer camp and divided into two groups: the "Eagles" and the "Rattlers." In a competitive context characterized by scarce resources—where one group' s success would adversely affect the other—the two groups developed negative intergroup evaluations and behaviors. Subsequently, when the groups faced a series of problems requiring joint solutions in a cooperative context involving common interests, they reconciled and formed positive intergroup evaluations (Sherif, Harvey, White, Hood, & Sherif, 1961). Additionally, researchers have found that physical settings such as bright versus dark environments also affect intergroup evaluation, with people exhibiting more negative intergroup evaluations toward outgroup members in dark settings (Schaller, Park, & Faulkner, 2003).

Recently, researchers have increasingly focused on how intergroup evaluation is affected by the dynamic evolution of situational factors such as group interaction (Durrheim, Quayle, Tredoux, Titlestad, & Tooke, 2016). For example, Chen and Li (2009) found that as time and rounds progressed, the difference in monetary allocations between ingroup and outgroup members gradually increased. Cacault, Goette, Lalive, and Thoenig (2015) demonstrated that outgroup aggression in earlier rounds influenced subsequent altruistic giving toward the group. Similarly, Dorrough, Glöckner, Hellmann, and Ebert (2015) found no significant differences in evaluations of ingroup versus outgroup members in the first round, but as repeated contact increased in subsequent rounds, ingroup favoritism gradually intensified, particularly when group membership switched

between rounds 10 and 11, leading to more pronounced changes in intergroup evaluation. These findings indicate that intergroup evaluation is dynamically influenced by the behaviors and outcomes of intergroup interactions, manifesting clear situational interdependence.

However, such previous research has only examined the effects of simple, repeated interactions on intergroup behavior, without considering the nature and outcomes of these interactions. Changes in intergroup behavior after repeated contact in competitive relationships likely differ from those in cooperative relationships. According to Social Interdependence Theory, two types of interdependent relationships exist in social interaction: cooperation and competition. In cooperative interdependence, individual success is based on others' success, seeking win-win outcomes, with collaborators sharing responsibility and maintaining harmonious relationships. In competitive interdependence, individual success comes at the expense of others' failure, with parties competing against each other and maintaining negative opposition (Johnson, 2003; Uskul & Over, 2017). Research indicates that perceived group threat serves as an important mechanism in both positive and negative intergroup contact (Kanas, Scheepers, & Sterkens, 2017). In competitive interdependence, people perceive higher group threat, leading to more negative intergroup evaluations. Compared to competitive relationships, cooperative interdependence can significantly reduce group members' tension and sense of threat (Wolgast & Fischer, 2017), which in turn leads to stronger ingroup identification, ingroup favoritism, and outgroup derogation. For disadvantaged groups, establishing cooperative interdependence with advantaged groups can even temporarily eliminate the psychological and behavioral effects of long-term disadvantaged status. For instance, when collaborating with men on spatial tasks, the performance deficits previously exhibited by women under stereotype threat regarding "poor spatial ability" are significantly reduced or even completely eliminated (Wen, Zuo, Wu, Dong, & Wang, 2016). Therefore, when examining changes in intergroup behavior throughout the entire interaction process, it is necessary to further investigate the effects of different interaction natures or outcomes (Dovidio, Love, Schellhaas, & Hewstone, 2017). Additionally, research has shown that positive and negative intergroup contacts produce asymmetric psychological effects, with negative contact more significantly increasing prejudice and avoidance behaviors (Hayward, Tropp, Hornsey, & Barlow, 2017). How, then, do success and failure outcomes —positive and negative results—in competitive versus cooperative contexts influence the evolution of intergroup evaluation? The present research aims to explore this question.

People' s evaluations of groups may also be influenced by the dimensions of evaluation and the relationships between these dimensions (Rast, Gaffney, & Yang, 2017). The "Big Two" model of social cognition suggests that people commonly evaluate others through two dimensions: warmth and competence (Cislak & Wojciske, 2008; Zuo et al., 2015). Warmth, as an indicator of others' behavioral intentions, reflects people' s need to form and maintain social connections, representing others' friendliness, helpfulness, and trustworthiness. Competence, as an

indicator of the degree and likelihood that someone can achieve their intentions and goals, represents others' intelligence, skills, and efficiency (Abele et al., 2016; Fiske, Cuddy, & Glick, 2007; Fiske, 2018; Clough & Bates, 2017). In actual person perception, the relationship between warmth and competence is complex. Beyond being influenced by the target' s actual characteristics, evaluations on these two dimensions also affect each other. Broadly speaking, two types of relationships may exist between warmth and competence: a positive relationship, such as the halo effect, and a negative relationship, such as compensation effects and innuendo effects (Zuo, Dai, Wen, & Teng, 2014).

Existing experimental research has found that warmth and competence may exhibit a positive relationship. For example, Judd et al. (2005) presented participants with two virtual groups differing in competence or warmth levels and asked them to evaluate one group' s warmth and competence. The results revealed a halo effect in group warmth and competence perception: when the target was perceived as high in warmth or competence, perceivers also rated the other dimension highly, and vice versa. However, it is worth noting that in Judd et al.' s (2005) experiment, although the high-competence group scored higher on warmth than the low-competence group, the difference did not reach statistical significance (Zuo et al., 2014). Meanwhile, other researchers have found that warmth and competence may exhibit a negative relationship. For instance, studies on compensation effects have shown that when two social targets differ on warmth or competence, people compensate by rating the other dimension in the opposite direction (Kervyn, Yzerbyt, Judd, & Nunes, 2009; Kervyn, Yzerbyt, & Judd, 2011). Similarly, research on innuendo effects has found that when participants are presented with only positive descriptions of a target on one dimension (warmth or competence), they infer negativity on the other dimension (Kervyn, Bergsieker, & Fiske, 2012). These studies predominantly adopt a single-dimension information presentation perspective, presenting participants with information on only one dimension (warmth or competence) and asking them to infer the target' s standing on the other dimension. As can be seen, research based on single-dimension presentation of warmth and competence information yields complex and inconsistent results regarding the relationship between these two dimensions.

Therefore, this research aims to investigate how people evaluate outgroup members with different levels of warmth or competence. First, based on Asch' s (1946) theory of warmth as a central trait and the warmth primacy effect (Fiske et al., 2007; Abele, Bruckmüller, & Wojciszke, 2014), we hypothesize that when inferring competence from warmth-related information, a positive halo effect relationship will emerge. Specifically, people will make similar judgments about high-warmth outgroups as they would about high-warmth-high-competence outgroups, and similar judgments about low-warmth outgroups as they would about low-warmth-low-competence outgroups. Second, regarding inferences from competence to warmth, analysis of previous research revealing negative relationships between warmth and competence shows that compensation and innuendo effects always depend on certain comparative task contexts (Kervyn et al., 2011;

Dai, Zuo, & Wen, 2014). The contextual conditions underlying these negative relationships may be more strongly influenced by the competence dimension. Therefore, we hypothesize that when inferring warmth from competence-related information, a negative relationship will exist. People will make similar judgments about high-competence outgroups as they would about high-competence-low-warmth outgroups, and similar judgments about low-competence outgroups as they would about low-competence-high-warmth outgroups. Building on this foundation, this paper further examines the impact of single-dimension versus dual-dimension information presentation on intergroup evaluation, investigating whether perceptions of groups presented with combined warmth and competence information from the Stereotype Content Model (SCM)—high warmth-high competence, low warmth-low competence, low warmth-high competence, and high warmth-low competence—differ from evaluations based on single-dimension information only.

According to the perspective of consistent interdependence in intergroup evaluation, people do not make simple, pure perceptual judgments of outgroup warmth and competence; rather, these judgments are often influenced by factors such as context. Previous research on contextual factors affecting warmth and competence perception has primarily focused on task contexts matched separately to warmth and competence, such as social and academic task contexts (Kervyn et al., 2012), and everyday conflict situations from realistic group conflict theory (Ufkes, Otten, van der Zee, Giebels, & Dovidio, 2011). No research has yet addressed competition and cooperation—the two primary contexts of modern social group interaction. This study attempts to explore the dynamic evolution of outgroup warmth and competence perception across two phases: the pre-action intention evaluation stage and the post-action success/failure outcome stage, within both competitive and cooperative contexts.

Current theoretical explanations for the relationship between the warmth/competence dimensions and competitive/cooperative contexts differ in important ways. First, from an evolutionary psychology perspective, the Stereotype Content Model posits that stereotypes are rooted in universal social phenomena: for self-interest and survival, people unconsciously ascertain whether other groups are friends or foes (i.e., warmth) and whether they pose a threat (i.e., competence) (Fiske, 1993; Bettelheim & Janowitz, 1950; Zuo, Zhang, Zhao, & Wang, 2009). Based on this view, we can infer that before competitive or cooperative actions—during the stage of learning about outgroup intentions—people' s judgments of outgroups may not be influenced by specific situational contexts. Instead, they may more spontaneously or unconsciously lower their warmth evaluations of outgroup members based on considerations of increasing defense and reducing threat, thereby avoiding catastrophic consequences from misjudging intentions. From an evolutionary perspective, we can formulate the following hypotheses: On one hand, for survival considerations, to reduce false judgments of "friendliness" in high-warmth outgroups and to enhance accurate perception of potential threats from low-competence outgroups, people may unconsciously lower their warmth judgments of high-warmth outgroups and

raise their competence perceptions of low-competence outgroups. On the other hand, for self-interest considerations, to facilitate effective interaction with low-warmth outgroups and to maintain equal status when interacting with high-competence outgroups, people may spontaneously increase their warmth perceptions of low-warmth outgroups and decrease their competence perceptions of high-competence outgroups. In summary, during the pre-action intention evaluation stage, people' s warmth and competence perceptions of outgroups will exhibit a "centralizing" or balancing tendency.

Second, from an ontological and functional perspective, humans exist by maintaining both self-interested and affiliative states (Bakan, 1966), with the competence and warmth dimensions corresponding to these two existential states, respectively. Warmth and competence evaluations reflect the two major tasks people face in the real world: gaining social acceptance and forming social connections with others, and obtaining competence affirmation and social status. According to the functional perspective, group warmth and competence stereotype perceptions in the SCM do not simply reflect accurate cognition of group members. From a functionalist and pragmatic viewpoint, warmth and competence perceptions serve more to reflect and maintain the intergroup relational system (Abele et al., 2014). Based on ontological and functional explanations, we can infer that in the post-action success/failure outcome stage of competition and cooperation, people' s warmth and competence judgments of outgroups depend more on the trade-off considerations between self-interest and affiliation. We hypothesize that in competitive contexts, when successfully competing against outgroup members, people will increase their warmth evaluations to maintain affiliative aspects of intergroup interaction, while decreasing their competence evaluations to enhance self-competence and status. When competition fails, based on affiliative considerations, people will decrease their warmth evaluations, while based on self-interest considerations, they will increase their competence evaluations. In cooperative contexts, when cooperating successfully with outgroups, people' s warmth and competence evaluations of outgroups will both increase, whereas when cooperation fails, they will simultaneously decrease both warmth and competence evaluations.

Overall, this research aims to examine the dynamic evolution of people's warmth and competence perceptions of outgroups across different competitive and cooperative contexts involving evaluative intentions and various success/failure outcomes, adopting both single-dimension and dual-dimension perspectives on warmth and competence. Specifically, Study 1, based on a single-dimension perspective, uses two experiments to examine intergroup evaluation during initial contact, evaluative intention, and success/failure outcome stages in both cooperative and competitive contexts. Study 2, based on a dual-dimension perspective, similarly uses two experiments to examine the evolution of intergroup evaluation across these same stages in cooperative and competitive contexts.

2.1 Research Objectives and Hypotheses

Based on a single-dimension information presentation perspective of warmth and competence, Experiments 1 and 2 examine how people' s warmth and competence perceptions of outgroup members evolve across four situations—initial contact, learning of intentions, task success, and task failure—in competitive and cooperative contexts, respectively. The research hypotheses are: (1) During the pre-action evaluative intention stage, warmth and competence perceptions of outgroups will exhibit a "centralizing" or balancing tendency. (2) In competitive contexts, when successfully competing against outgroup members, competence evaluations of outgroups will decrease; when competition fails, competence evaluations will increase. In cooperative contexts, when cooperating successfully with outgroups, both warmth and competence evaluations will increase; when cooperation fails, both warmth and competence evaluations will decrease.

Experiment 1: Competitive Context

Experiment 1 aims to explore the evolution of warmth and competence evaluations of outgroup members with different stereotype content (high competence, low competence, high warmth, and low warmth) across four different situations in a competitive context: initial contact, learning of competitive intentions, competitive success, and competitive failure.

2.2.1 Participants

The study recruited 102 undergraduate students from a university in Wuhan, including 24 males and 78 females, with a mean age of 24.04 years (SD = [value missing in original]).

2.2.2 Experimental Design

A within-subjects design was employed with three factors: 4 (stereotype content: high warmth, low warmth, high competence, low competence) × 4 (evaluation situation: initial contact, learning of intentions, task success, task failure) × 2 (evaluation dimension: warmth, competence). The dependent variable was participants' warmth and competence evaluations of outgroup members across different situations, measured using trait words from the stereotype content questionnaire on a 7-point scale. Warmth traits included "warm" and "friendly," while competence traits included "intelligent" and "competent" (Abele et al., 2014).

2.2.3 Experimental Materials

The Distant Planetary Paradigm, a variation developed by Ufkes et al. (2011), was used to manipulate different levels of warmth and competence dimensions in stereotype content. The Distant Planetary Paradigm was originally proposed by Hoffman and Hurst (1990) to demonstrate how traits become stereotypically

associated with category groups (e.g., whether gender stereotypes stem from reasoning about different distributions of social roles). They argued that familiar category groups could not be used in research; to exclude the influence of pre-existing impressions about familiar categories, they created virtual groups on distant planets to manipulate categories. Hoffman et al. used two types of virtual category members on a distant planet: one with 80% "child-rearers" and 20% "city workers," and the other with 20% "child-rearers" and 80% "city workers," specifying that this planet had no males or females to manipulate category conditions. This method cleverly led participants to form stereotypical impressions based on social role categories.

Building on Hoffman et al.' s work, Ufkes et al. (2011) developed a variation of the Distant Planetary Paradigm by presenting participants with different trait information descriptions of extraterrestrial virtual groups to manipulate warmth and competence dimensions in stereotype content. For example, for aliens on the distant planet Morfs, high warmth descriptions included high EQ (mean 130, range 120-140), friendly, and sociable; low warmth descriptions included low EQ (mean 70, range 60-80), selfish, and aggressive; high competence descriptions included high IQ (mean 130, range 120-140), intelligent, and capable; low competence descriptions included low IQ (mean 70, range 60-80), inefficient, and foolish. This variation can exclude confounds from participants' pre-existing beliefs about real groups, and both the subsequent open-ended questions about IQ/EQ evaluations and the stereotype content questionnaire measurements (e.g., "I think Morfs are friendly") demonstrated the effectiveness of this manipulation.

The current study used a method similar to Ufkes et al. (2011) with a within-subjects design, creating four virtual extraterrestrial groups with meaningless letter combinations as names: the high-EQ "Wahrn" group, the low-EQ "Lsejt" group, the low-IQ "Morlc" group, and the high-IQ "Zaufs" group. Using the Distant Planetary Paradigm to create virtual species (groups) prevents participants from associating them with any real existing groups, ensuring that any observed effects are caused by stereotype content. This method also cleverly excludes interference from pre-existing beliefs about real groups and irrelevant cues. The paradigm then involved designing a "contest to determine mining rights for planetary resources" between participants and the Morfs, with contest outcomes manipulated to represent success and failure.

2.2.4 Experimental Procedure

Participants were informed that the experiment aimed to explore people' s genuine feelings and reactions in special situations, and were asked to immerse themselves in the scenarios and respond based on their true feelings. They were then introduced to information about a virtual group from a distant planet, including the group' s overall EQ/IQ levels and corresponding typical member traits. To ensure participants understood the EQ/IQ concepts, they were first shown the meaning of these concepts and their distributions (average level for normal humans is 100, normal range is 85 to 115) before being introduced to

the virtual groups.

Experiment 1 systematically manipulated warmth and competence in stereotype content by varying the virtual group descriptions. In the low-warmth condition, the virtual group was described as having low emotional intelligence (average level of 70, range 60-80), with members generally being cold, selfish, and aggressive. In the high-warmth condition, the virtual group was described as having high emotional intelligence (average level of 130, range 120-140), with members generally being warm, friendly, and gentle. Competence stereotype manipulation followed a similar pattern. The low-competence virtual group had low intelligence characteristics (average level of 70, range 60-80), with members generally being foolish, inefficient, and incompetent. The high-competence virtual group had high intelligence (average level of 130, range 120-140), with members generally being intelligent, capable, and efficient. Participants were asked to evaluate targets at different stages:

(1) **Initial contact stage**: Participants directly evaluated the warmth and competence of the described outgroup members.

(2) **Learning of intentions stage**: In the competitive context, participants were presented with situational instructions asking them to imagine that due to resource scarcity on Earth, they and their team represented Earth in mining an energy source on a planet, but a virtual group also coveted that planet' s energy. Their team and the virtual group reached an agreement to determine mining rights through a contest. Participants then evaluated the outgroup members' warmth and competence.

(3) **Task success stage**: Participants were further asked to imagine: "As a result, you won the contest and obtained the planet' s energy." They then evaluated the outgroup members' warmth and competence.

(4) **Task failure stage**: Participants were asked to imagine: "However, unfortunately, you lost the contest and lost the planet' s energy." They then made final warmth and competence evaluations of the outgroup members.

2.2.5 Results Analysis

(1) Manipulation Check Results First, we conducted manipulation checks on the warmth and competence impressions formed by the Distant Planetary Paradigm. We calculated the mean trait evaluation scores for warmth and competence dimensions during initial contact: high warmth ($M = 6.02$, $SD = 0.95$); low warmth ($M = 2.18$, $SD = 1.21$); high competence ($M = 5.85$, $SD = 1.03$); low warmth ($M = 2.67$, $SD = 1.19$). Independent samples t-tests against the midpoint of the 7-point scale (4) revealed significant differences ($ps < 0.001$), confirming the effectiveness of the Distant Planetary Paradigm in manipulating stereotype content.

(2) Descriptive Statistics Results In the competitive context, descriptive statistics for people's warmth and competence perceptions of outgroup members with different stereotype content (high warmth, low warmth, high competence, low competence) across the four situational stages (initial contact, learning of intentions, task success, task failure) are presented in Table 1 .

(3) Warmth and Competence Evaluations of Outgroups with Different Stereotype Content Across Four Situational Stages A three-factor within-subjects design was conducted on participants' rating data: 4 (situation) × 4 (target) × 2 (dimension). The results, shown in Figure 1 [Figure 1: see original paper], revealed a significant three-way interaction, $F(9, 945) = 22.74$, $p < 0.001$, $p^2 = 0.18$. All main effects and two-way interactions were also significant ($p < 0.001$). To test our hypotheses more precisely, we divided the data into two partial interaction components based on the degree of situational change: "initial contact-learning of competitive intentions-success" and "initial contact-learning of cooperative intentions-failure."

In the "success" condition (ignoring the "failure" level), the three-way interaction was significant, $F(6, 100) = 13.78$, $p < 0.001$, $p^2 = 0.45$. To examine how warmth and competence evaluations changed continuously across situations, we treated situation as a continuous variable and conducted trend analyses to investigate how this linear change trend was moderated by dimension and target.

First, the overall linear trend across situations was highly significant, $F(1, 105) = 40.44$, $p < 0.001$, $p^2 = 0.28$, while the overall quadratic trend was not significant, $F(1, 105) = 0.43$, $p = 0.51$. In other words, considering only the situational trend, there was a general linear decline from initial meeting through learning of competitive intentions to success, when ignoring evaluation dimension and target. Building on this, we further examined potential moderating effects of dimension and target. Analysis of the linear trend revealed a significant three-way interaction, $F(3, 103) = 26.04$, $p < 0.001$, $p^2 = 0.43$, indicating that the linear trend of ratings across situations was significantly moderated by evaluation dimension and target.

Examining simple interaction effects from the target perspective, all four target types showed significant simple interactions, but with different patterns ($ps < 0.001$). When evaluating high-warmth outgroups, both warmth [$F(1, 105) = 58.98$, $p < 0.001$, $p^2 = 0.36$] and competence dimensions [$F(1, 105) = 18.41$, $p < 0.001$, $p^2 = 0.15$] showed significant linear decreasing trends as the situation changed, with a greater decrease on the warmth dimension. When evaluating low-warmth targets, warmth showed a significant linear increasing trend [$F(1, 105) = 17.60$, $p < 0.001$, $p^2 = 0.14$], while competence showed a significant decreasing trend [$F(1, 105) = 13.51$, $p < 0.001$, $p^2 = 0.11$]. When evaluating high-competence targets, the linear trend for warmth was not significant [$F(1, 105) = 2.43$, $p = 0.12$, $p^2 = 0.02$], while competence showed a significant decreasing trend [$F(1, 105) = 75.90$, $p < 0.001$, $p^2 = 0.42$]. When evaluating low-competence targets, warmth showed a significant decreasing trend [F(1,

105) = 15.48, p < 0.001, p^2 = 0.13], while the linear trend for competence was not significant [F(1, 105) = 0.95, p = 0.33, p^2 = 0.01].

The three-way interaction treating situation as a quadratic trend was significant, F(3, 103) = 244.727, p < 0.001, p^2 = 0.88. For this significant three-way interaction, examining from the dimension perspective revealed a significant simple interaction between target and situation on the warmth dimension [F(3, 103) = 5.120, p < 0.01, p^2 = 0.13], but not on the competence dimension [F(3, 103) = 1.80, p = 0.15, p^2 = 0.05]. In other words, when evaluating targets across the four types, participants' competence ratings showed an overall quadratic trend of first increasing then decreasing [F(1, 105) = 68.41, p < 0.001, p^2 = 0.39], which did not differ significantly across targets. On the warmth dimension, the quadratic trend of situational change was significant only when evaluating high-warmth targets [F(1, 105) = 31.95, p < 0.001, p^2 = 0.23], high-competence targets [F(1, 105) = 15.73, p < 0.001, p^2 = 0.13], and low-competence targets [F(1, 105) = 9.74, p < 0.01, p^2 = 0.09], all showing a pattern of first decreasing then increasing.

In the "failure" condition (ignoring the "success" level), the three-way interaction was significant, F(6, 100) = 17.90, p < 0.001, p^2 = 0.52. To examine how warmth and competence evaluations changed continuously across situations, we conducted trend analyses treating situation as a continuous variable to test the linear and quadratic effects of situational change. The linear trend effect for situation was marginally significant [F(1, 105) = 3.64, p = 0.059, p^2 = 0.03], while the quadratic trend effect was significant [F(1, 105) = 53.01, p < 0.001, p^2 = 0.34]. However, although the main effect of the linear trend was not significant, this nonsignificant result might be related to interaction effects. Further analysis revealed a significant three-way interaction between the linear trend of situation, evaluation dimension, and target, F(3, 103) = 32.77, p < 0.001, p^2 = 0.49. For this significant three-way interaction, examining from the target perspective showed significant simple interactions between situational change and dimension for all four target types.

When evaluating high-warmth targets, warmth ratings showed a significant linear decreasing trend [F(1, 105) = 78.82, p < 0.001, p^2 = 0.43], while competence ratings showed a significant increasing trend [F(1, 105) = 31.73, p < 0.001, p^2 = 0.23] across the "initial meeting-learning of competitive intentions-failure" progression. When evaluating low-warmth targets, both warmth [F(1, 105) = 7.71, p < 0.01, p^2 = 0.07] and competence dimensions [F(1, 105) = 44.34, p < 0.001, p^2 = 0.30] showed increasing trends, with a more pronounced trend on the competence dimension. When evaluating high-competence targets, warmth ratings decreased significantly [F(1, 105) = 26.25, p < 0.001, p^2 = 0.20], while competence ratings did not change significantly [F(1, 105) = 1.79, p = 0.18, p^2 = 0.02]. When evaluating low-competence targets, warmth ratings showed a significant decreasing trend [F(1, 105) = 24.53, p < 0.001, p^2 = 0.19], while competence ratings showed a significant increasing trend [F(1, 105) = 145.90, p < 0.001, p^2 = 0.58].

The three-way interaction treating situation as a quadratic trend was significant, $F(3, 103) = 262.26$, $p < 0.001$, $p^2 = 0.88$. For this significant three-way interaction, examining from the target perspective revealed significant simple interaction effects when evaluating low-warmth outgroups [$F(1, 105) = 7.77$, $p < 0.01$, $p^2 = 0.07$] and low-competence outgroups [$F(1, 105) = 9.28$, $p < 0.01$, $p^2 = 0.08$], but not for the other two target types (ps > 0.24). Therefore, we examined low-warmth and low-competence outgroups separately. When evaluating low-warmth targets, the quadratic trend was not significant for warmth ($p = 0.57$) but was highly significant for competence [$F(1, 105) = 14.70$, $p < 0.001$, $p^2 = 0.12$], showing a pattern of first decreasing then increasing. When evaluating low-competence targets, warmth change was not significant ($p = 0.16$), while competence showed a significant quadratic trend of first decreasing then increasing [$F(1, 117) = 26.57$, $p < 0.001$, $p^2 = 0.20$].

2.2.6 Discussion

From the analysis of warmth and competence evaluation trends for outgroup members with different stereotype content across the four competitive situations (see Figure 1), several patterns emerge: (1) During the evaluative intention stage—when informed about impending competition with the outgroup—people showed opposite-direction changes in warmth and competence for high-warmth and low-competence outgroups (warmth decreasing, competence increasing). For low-warmth outgroups, both warmth and competence increased, while for high-competence outgroups, both warmth and competence decreased, showing same-direction changes. (2) During the outcome evaluation stage—when imagining success and failure outcomes after competing with the outgroup—in the competitive success stage, warmth increased and competence decreased for high-warmth, low-warmth, and high-competence outgroups, except for low-competence outgroups where both warmth and competence decreased. In the competitive failure stage, warmth decreased and competence increased for all outgroup types: high-warmth, low-warmth, high-competence, and low-competence.

2.3 Experiment 2: Cooperative Context

Unlike Experiment 1, Experiment 2 aims to explore the evolution of warmth and competence evaluations of outgroup members with different stereotype content (high competence, low competence, high warmth, and low warmth) across four different situations in a cooperative context: initial contact, learning of cooperative intentions, cooperative success, and cooperative failure.

2.3.1 Participants

The study recruited 148 undergraduate students from a university in Wuhan, including 63 males and 85 females, with a mean age of 21.67 years (SD = [value missing]).

2.3.2 Experimental Design

The same experimental design as Experiment 1 was used, with the dependent variable being participants' warmth and competence evaluation scores for outgroup members across the four situational stages (initial contact, learning of cooperative intentions, cooperative success, cooperative failure).

2.3.3 Experimental Materials

The materials were identical to those in Experiment 1, with the only difference being that the competitive context was replaced with a cooperative context.

2.3.4 Experimental Procedure

The overall procedure was identical to Experiment 1, except that the situational instructions differed. The competitive context from Experiment 1 was replaced with a cooperative context: "Your team and a virtual group reached an agreement to cooperate in finding technology to utilize the planet' s energy. The degree of your cooperation will determine whether you can successfully use the planet' s energy." In the success condition, participants were told: "As a result, your cooperation was successful, and you quickly mastered the technology to utilize the energy source, gaining new energy." In the failure condition, they were told: "However, unfortunately, your cooperation failed, and you never mastered the technology to utilize the energy source. Your team returned empty-handed."

2.3.5 Results Analysis

(1) Manipulation Check Results Manipulation checks on the warmth and competence impressions formed by the Distant Planetary Paradigm were conducted by calculating mean trait evaluation scores during initial contact: high warmth ($M = 5.82$, $SD = 1.13$); low warmth ($M = 2.40$, $SD = 1.37$); high competence ($M = 5.82$, $SD = 1.10$); low warmth ($M = 3.07$, $SD = 1.31$). Independent samples t-tests against the scale midpoint (4) revealed significant differences (ps < 0.001), confirming the effectiveness of the paradigm.

(2) Descriptive Statistics Results In the cooperative context, descriptive statistics for warmth and competence perceptions of outgroup members with different stereotype content (high warmth, low warmth, high competence, low competence) across the four situational stages (initial contact, learning of intentions, task success, task failure) are presented in Table 2 .

(3) Warmth and Competence Evaluations of Outgroups with Different Stereotype Content Across Four Situational Stages A three-factor within-subjects design was conducted: 4 (situation) × 4 (target) × 2 (dimension). The results, shown in Figure 2 [Figure 2: see original paper], revealed a significant three-way interaction, $F(9, 1368) = 62.62$, $p < 0.001$, $p^2 = 0.29$. All main effects and two-way interactions were significant ($p < 0.001$), except for

the situation × dimension interaction ($p = 0.32$). Following the same analytic approach as Experiment 1, we examined partial interactions for success and failure conditions separately.

In the "success" condition (ignoring the "failure" level), the three-way interaction was significant, $F(6, 147) = 41.42$, $p < 0.001$, $p^2 = 0.63$. To examine how warmth and competence evaluations changed continuously across situations, we treated situation as a continuous variable and conducted trend analyses to investigate how the linear change trend was moderated by dimension and target.

First, the overall linear trend across situations was highly significant, $F(1, 152) = 261.94$, $p < 0.001$, $p^2 = 0.63$, as was the overall quadratic trend, $F(1, 152) = 102.07$, $p < 0.001$, $p^2 = 0.40$. In other words, considering only the situational trend, there was a general linear increase from initial meeting through learning of cooperative intentions to success, when ignoring evaluation dimension and target. Additionally, this gradual increase contained a significant quadratic trend, indicating that the overall increase followed a pattern of first decreasing then increasing.

Building on this, we further examined potential moderating effects of dimension and target. Analysis of the linear trend revealed a significant three-way interaction, $F(3, 150) = 46.23$, $p < 0.001$, $p^2 = 0.48$, indicating that the linear trend of ratings across situations was significantly moderated by evaluation dimension and target. Examining simple interaction effects from the target perspective revealed significant simple interactions for all four target types, but with different patterns ($ps < 0.001$). When evaluating high-warmth targets, both competence [$F(1, 150) = 47.50$, $p < 0.001$, $p^2 = 0.24$] and warmth dimensions [$F(1, 150) = 4.12$, $p < 0.05$, $p^2 = 0.03$] showed significant linear increasing trends, with a greater increase on the competence dimension. When evaluating low-warmth targets, both warmth [$F(1, 150) = 172.75$, $p < 0.001$, $p^2 = 0.53$] and competence dimensions [$F(1, 150) = 66.26$, $p < 0.001$, $p^2 = 0.30$] showed significant linear increasing trends, with a greater increase on the warmth dimension. When evaluating high-competence targets, both warmth [$F(1, 150) = 78.859$, $p < 0.001$, $p^2 = 0.342$] and competence dimensions [$F(1, 150) = 6.227$, $p = 0.014$, $p^2 = 0.039$] showed significant linear increasing trends, with a greater increase on the warmth dimension. When evaluating low-competence targets, both warmth [$F(1, 150) = 31.89$, $p < 0.001$, $p^2 = 0.17$] and competence dimensions [$F(1, 150) = 194.60$, $p < 0.001$, $p^2 = 0.56$] showed significant linear increasing trends, with a greater increase on the competence dimension. Overall, as the cooperative context evolved, participants' evaluations of outgroup members showed a general linear increase, but the magnitude of this increase differed across targets and dimensions. Specifically, for high-warmth and low-competence targets, competence increased more than warmth, while for low-warmth and high-competence targets, warmth increased more than competence, demonstrating a clear compensatory tendency.

The three-way interaction treating situation as a quadratic trend was significant, $F(3, 150) = 262.93$, $p < 0.001$, $p^2 = 0.84$. For this significant three-way interac-

tion, examining from the target perspective revealed that the simple interaction between dimension and situation was not significant for low-warmth targets [$F(1, 152) = 0.18$, $p = 0.67$, $p^2 = 0.001$], indicating no quadratic trend on either dimension when evaluating low-warmth targets. The simple interactions were significant for the other three target types (ps < 0.05). Further analysis of the significant simple interaction for high-warmth targets revealed that the quadratic trend was not significant for competence [$F(1, 152) = 1.75$, $p = 0.19$, $p^2 = 0.01$], but was significant for warmth [$F(1, 152) = 21.43$, $p < 0.001$, $p^2 = 0.12$], showing a pattern of first decreasing then increasing. For high-competence targets, both competence [$F(1, 152) = 27.17$, $p < 0.001$, $p^2 = 0.15$] and warmth dimensions [$F(1, 152) = 7.07$, $p < 0.01$, $p^2 = 0.04$] showed significant quadratic trends, but this pattern was more pronounced on the competence dimension. For low-competence targets, warmth showed a highly significant quadratic trend of first decreasing then increasing [$F(1, 152) = 181.51$, $p < 0.001$, $p^2 = 0.54$], while the quadratic trend for competence was only marginally significant [$F(1, 152) = 3.76$, $p = 0.05$, $p^2 = 0.02$].

In the "failure" condition (ignoring the "success" level), the three-way interaction was significant, $F(6, 147) = 40.01$, $p < 0.001$, $p^2 = 0.62$. To examine how warmth and competence evaluations changed continuously across situations, we treated situation as a continuous variable and conducted trend analyses to test the linear and quadratic effects of situational change. The linear trend effect for situation was significant, $F(1, 152) = 49.39$, $p < 0.001$, $p^2 = 0.25$, as was the quadratic trend effect, $F(1, 152) = 22.02$, $p < 0.001$, $p^2 = 0.13$. Further analysis revealed a significant three-way interaction between the linear trend of situation, evaluation dimension, and target, $F(3, 150) = 17.01$, $p < 0.001$, $p^2 = 0.25$. For this significant three-way interaction, examining from the target perspective showed that the simple interaction between situation and dimension was only marginally significant when evaluating high-warmth targets ($p = 0.07$), but was significant for low-warmth, high-competence, and low-competence targets (ps < 0.001). Specifically, when evaluating low-warmth targets, competence ratings decreased gradually [$F(1, 152) = 6.64$, $p = 0.01$, $p^2 = 0.04$], while warmth ratings increased [$F(1, 152) = 8.21$, $p < 0.001$, $p^2 = 0.05$], with both linear trends being significant. For high-competence targets, both competence [$F(1, 152) = 53.83$, $p < 0.001$, $p^2 = 0.262$] and warmth dimensions [$F(1, 152) = 17.18$, $p < 0.001$, $p^2 = 0.102$] showed significant decreasing trends, with a stronger trend on the competence dimension. For low-competence targets, competence showed a significant increasing trend [$F(1, 152) = 5.46$, $p = 0.02$, $p^2 = 0.04$], while warmth showed a significant decreasing trend [$F(1, 152) = 45.41$, $p < 0.001$, $p^2 = 0.23$].

Notably, because the contrast between learning of cooperative intentions and cooperative failure was substantial, participants' evaluations might show reversals that cannot be fully captured by linear trends. Therefore, we further examined quadratic trends. The three-way interaction treating situation as a quadratic trend was significant, $F(3, 150) = 215.38$, $p < 0.001$, $p^2 = 0.81$. For this significant three-way interaction, examining from the target perspective revealed

that the simple interaction between situation and dimension was not significant when evaluating low-warmth-high-competence outgroups ($p = 0.21$), but was significant for the other three target types ($ps < 0.001$). When evaluating high-warmth targets, both competence [$F(1, 152) = 60.30$, $p < 0.001$, $p^2 = 0.28$] and warmth dimensions [$F(1, 152) = 11.85$, $p < 0.001$, $p^2 = 0.07$] showed significant quadratic trends, with more pronounced changes on the competence dimension. For high-competence targets, the quadratic trend was not significant for competence ($p = 0.29$), but was significant for warmth [$F(1, 152) = 52.19$, $p < 0.001$, $p^2 = 0.26$]. For low-competence targets, competence showed a significant quadratic trend of first increasing then decreasing [$F(1, 152) = 80.96$, $p < 0.001$, $p^2 = 0.35$], while warmth showed a significant quadratic trend of first decreasing then increasing [$F(1, 152) = 77.14$, $p < 0.001$, $p^2 = 0.34$].

2.3.6 Discussion

Examining the warmth and competence evaluation trends for outgroup members with different stereotype content across the four cooperative situations (see Figure 2) reveals that during the evaluative intention stage—when informed about impending cooperation with the outgroup—people showed the same warmth-decreasing, competence-increasing pattern for high-warmth and low-competence outgroups as in the competitive context. Similarly, for low-warmth outgroups, both warmth and competence increased, matching the competitive context pattern. However, unlike the competitive context, for high-competence outgroups in the cooperative context, warmth increased while competence decreased. During the outcome evaluation stage—when imagining success and failure outcomes after cooperating with the outgroup—unlike competitive success, cooperative success led to increases in both warmth and competence for high-warmth, low-warmth, high-competence, and low-competence outgroups. Similarly, unlike competitive failure, cooperative failure led to decreases in both warmth and competence for all outgroup types.

3.1 Research Objectives and Hypotheses

Study 1 primarily examined single-dimension presentation of stereotype content, investigating warmth and competence dimensions independently in outgroup member descriptions, with the other dimension being inferred. Building on this, Study 2 adopts a dual-dimension perspective by simultaneously presenting combined warmth and competence descriptions to examine how the two dimensions of stereotype content affect competitive and cooperative behaviors, providing a replication test of our main findings. The hypotheses are: Based on the dual-dimension perspective, results will be similar to the single-dimension perspective. (1) During the pre-action evaluative intention stage, warmth and competence evaluations of outgroups will exhibit a "centralizing" balancing tendency. (2) In competitive contexts, when successfully competing against outgroup members, competence evaluations will decrease; when competition fails, competence evaluations will increase. In cooperative contexts, when cooperating successfully

with outgroups, both warmth and competence evaluations will increase; when cooperation fails, both warmth and competence evaluations will decrease.

Experiment 3

Experiment 3 differs from Experiment 1 in that the Distant Planetary Paradigm presents outgroup members with combined warmth and competence descriptions. Using the same within-subjects design, it examines the evolution of warmth and competence evaluations of outgroup members with different stereotype content combinations (high warmth-high competence, high warmth-low competence, low warmth-high competence, and low warmth-low competence) across four situations (initial contact, learning of competitive intentions, competitive success, competitive failure) in a competitive context.

3.2.1 Participants

The study recruited 118 undergraduate students from a university in Wuhan, including 37 males and 81 females, with a mean age of 22.27 years (SD = [value missing]).

3.2.2 Experimental Design

The design was identical to Experiments 1 and 3, except that outgroup members were described using dual-dimension combinations: high warmth-high competence, low warmth-high competence, high warmth-low competence, and low warmth-low competence.

3.2.3 Experimental Materials

The materials differed from Experiment 1 in that the descriptions of the four virtual extraterrestrial groups in the Distant Planetary Paradigm variation changed from single-dimension to dual-dimension combinations: the "high EQ, high IQ" "Wahrn" group, the "low EQ, high IQ" "Lsejt" group, the "low EQ, low IQ" "Morlc" group, and the "high EQ, low IQ" "Zaufs" group.

3.2.4 Experimental Procedure

The procedure was identical to Experiment 1.

3.2.5 Results Analysis

(1) Manipulation Check Results Manipulation checks were conducted by calculating mean trait evaluation scores for warmth and competence dimensions during initial contact: high warmth-high competence combination (M_{high} warmth = 5.50, SD = 1.35; M_{high} competence = 6.04, SD = 1.12); low warmth-high competence combination (M_{low} warmth = 2.32, SD = 1.29;

M_{high} competence = 5.69, SD = 1.27); low warmth-low competence combination (M_{low} warmth = 2.63, SD = 1.59; M_{low} competence = 2.86, SD = 1.54); high warmth-low competence combination (M_{high} warmth = 5.78, SD = 1.20; M_{high} competence = 3.29, SD = 1.46). Independent samples t-tests against the scale midpoint (4) revealed significant differences (ps < 0.001), confirming the effectiveness of the paradigm.

(2) Descriptive Statistics Results In the competitive context, descriptive statistics for warmth and competence perceptions of outgroup members with different stereotype content (high warmth, low warmth, high competence, low competence) across the four situational stages (initial contact, learning of intentions, task success, task failure) are presented in Table 3 .

(3) Warmth and Competence Evaluations of Outgroups with Different Stereotype Content Across Four Competitive Situational Stages A three-factor within-subjects design was conducted: 4 (situation) × 4 (target) × 2 (dimension). The results, shown in Figure 3 [Figure 3: see original paper], revealed a significant three-way interaction, $F(9, 1053) = 22.65$, $p < 0.001$, $p^2 = 0.16$. All main effects and two-way interactions were significant ($p < 0.001$). Following the same analytic approach as Experiment 1, we examined partial interactions for success and failure conditions separately.

In the "success" condition (ignoring the "failure" level), the three-way interaction was significant, $F(6, 112) = 12.16$, $p < 0.001$, $p^2 = 0.40$. To examine how warmth and competence evaluations changed continuously across situations, we treated situation as a continuous variable and conducted trend analyses to test the linear and quadratic effects of situational change and how these trends were moderated by dimension and target.

First, the main effect of the linear trend across situations was significant, $F(1, 117) = 42.87$, $p < 0.001$, $p^2 = 0.27$, as was the main effect of the quadratic trend, $F(1, 117) = 13.76$, $p < 0.001$, $p^2 = 0.11$. This indicates that as competition progressed to its conclusion, participants' evaluations of outgroup members showed an overall decreasing trend on both competence and warmth dimensions, while also exhibiting some degree of quadratic trend (i.e., first increasing then decreasing, or first decreasing then increasing).

Consistent with our hypotheses, the linear trend across situations was significantly moderated by target and dimension, with a significant three-way interaction, $F(3, 115) = 16.09$, $p < 0.001$, $p^2 = 0.30$. For this significant three-way interaction, examining from the target perspective revealed that the simple interaction was not significant only when evaluating high-warmth-low-competence outgroups [$F(1, 117) = 0.213$, $p = 0.65$, $p^2 = 0.002$], but was significant for the other three target types ($p < 0.05$). Further examining simple simple effects from the dimension perspective revealed that for high-warmth-high-competence outgroups, both warmth and competence evaluations decreased significantly (ps < 0.001), but the decrease was greater on the competence dimension (warmth

vs. competence: -0.40 vs. -0.95), and the linear assumption explained a larger proportion of variance on the competence dimension ($p^2 = 0.08$ vs. 0.29). For low-warmth-high-competence targets, warmth ratings increased significantly ($p < 0.001$) while competence ratings decreased significantly ($p < 0.001$), with the linear assumption explaining a larger proportion of variance on the competence dimension ($p^2 = 0.12$ vs. 0.35). For low-warmth-low-competence targets, although the simple interaction was significant, examination from the dimension perspective revealed that the linear effect of situation was not significant on either warmth or competence dimensions (ps > 0.09), suggesting possible quadratic effects.

Given that multiple simple simple effects of linear trends showed low explanatory variance or were nonsignificant despite significant simple interactions, we further examined potential quadratic effects. The three-way interaction treating situation as a quadratic trend was also significant, $F(3, 115) = 204.98$, $p < 0.001$, $p^2 = 0.84$. For this significant three-way interaction, examining from the target perspective revealed significant simple interactions between dimension and situation for all four conditions, though effect sizes differed. For high-warmth-high-competence targets, both competence [$F(1, 117) = 20.03$, $p < 0.001$, $p^2 = 0.15$] and warmth [$F(1, 117) = 27.14$, $p < 0.001$, $p^2 = 0.19$] showed significant quadratic trends, but in opposite directions (0.87 vs. -0.66), with warmth showing a first-decrease-then-increase pattern and competence showing a first-increase-then-decrease pattern. For low-warmth-high-competence targets, the quadratic trend was not significant for warmth [$F(1, 117) = 0.001$, $p = 0.98$], but was significant for competence [$F(1, 117) = 21.77$, $p < 0.001$, $p^2 = 0.16$], showing a first-increase-then-decrease pattern. For high-warmth-low-competence targets, both warmth [$F(1, 117) = 11.91$, $p < 0.001$, $p^2 = 0.09$] and competence [$F(1, 117) = 34.57$, $p < 0.001$, $p^2 = 0.23$] showed significant quadratic trends in opposite directions (0.51 vs. -1.13), with warmth showing a first-decrease-then-increase pattern and competence showing a first-increase-then-decrease pattern. For low-warmth-low-competence targets, warmth ratings were not significant [$F(1, 117) = 0.39$, $p = 0.53$], while competence ratings showed a quadratic trend [$F(1, 117) = 28.02$, $p < 0.001$, $p^2 = 0.19$], exhibiting a first-increase-then-decrease pattern.

In the "failure" condition (ignoring the "success" level), the three-way interaction was significant, $F(6, 112) = 20.11$, $p < 0.001$, $p^2 = 0.52$. To examine how warmth and competence evaluations changed continuously across situations, we treated situation as a continuous variable and conducted trend analyses to test the linear and quadratic effects of situational change. First, the linear trend effect for situation was not significant, $F(1, 117) = 0.14$, $p = 0.71$, while the quadratic trend effect was significant, $F(1, 117) = 5.56$, $p = 0.02$, $p^2 = 0.05$.

However, although the main effect of the linear trend was not significant, this nonsignificant result might be related to interaction effects. Further analysis indeed revealed a significant three-way interaction between the linear trend of situation, evaluation dimension, and target, $F(3, 115) = 24.10$, $p < 0.001$, $p^2 =$

0.39. For this significant three-way interaction, examining from the target perspective revealed that the simple interaction between situation and dimension was only marginally significant when evaluating low-warmth-high-competence targets ($p = 0.07$), but was highly significant for the other three target types (ps < 0.001). When evaluating high-warmth-high-competence targets, the linear trend for warmth was highly significant [$F(1, 117) = 41.71$, $p < 0.001$, $p^2 = 0.26$], with warmth ratings decreasing gradually as the competitive situation progressed, while competence ratings showed only a marginal decreasing trend [$F(1, 117) = 2.76$, $p < 0.10$, $p^2 = 0.02$]. When evaluating high-warmth-low-competence targets, linear trends were significant for both dimensions (ps $<$ 0.001) but in opposite directions: warmth decreased while competence increased. Finally, when evaluating low-warmth-low-competence targets, warmth ratings did not change significantly ($p = 0.88$), while competence showed a significant linear increasing trend [$F(1, 117) = 63.81$, $p < 0.001$, $p^2 = 0.35$].

The three-way interaction treating situation as a quadratic trend was significant, $F(3, 115) = 240.35$, $p < 0.001$, $p^2 = 0.86$. For this significant three-way interaction, examining from the target perspective revealed significant simple interaction effects when evaluating high-warmth-low-competence outgroups [$F(1, 117) = 6.60$, $p = 0.01$, $p^2 = 0.05$] and low-warmth-low-competence outgroups [$F(1, 117) = 12.94$, $p < 0.001$, $p^2 = 0.10$], but not for the other two target types (ps > 0.05). Therefore, we examined high-warmth-low-competence and low-warmth-low-competence targets separately. When evaluating high-warmth-low-competence targets, warmth change was not significant ($p = 0.76$), while competence showed a highly significant quadratic trend [$F(1, 117) = 15.83$, $p <$ 0.001, $p^2 = 0.12$], exhibiting a first-decrease-then-increase pattern. When evaluating low-warmth-low-competence targets, warmth change was not significant ($p = 0.13$), while competence showed a significant first-decrease-then-increase quadratic trend [$F(1, 117) = 7.93$, $p < 0.05$, $p^2 = 0.06$].

3.2.6 Discussion

From the warmth and competence evaluation trends for outgroup members with different stereotype content across the four competitive situations based on dual-dimension information presentation, we can see that during the evaluative intention stage—when informed about impending competition with the outgroup—people showed similar same-direction change patterns for high-warmth-high-competence and low-warmth-low-competence outgroups: evaluations of high-warmth-high-competence outgroups decreased on both dimensions, while evaluations of low-warmth-low-competence outgroups increased on both dimensions. For low-warmth-high-competence and high-warmth-low-competence outgroups, people showed opposite-direction change patterns: warmth increased while competence decreased for low-warmth-high-competence outgroups, and warmth decreased while competence increased for high-warmth-low-competence outgroups. During the outcome evaluation stage—when imagining success and failure outcomes after competing with the outgroup—

similar to the single-dimension results, in the competitive success stage, warmth increased and competence decreased for high-warmth-high-competence, low-warmth-low-competence, and low-warmth-high-competence outgroups, except for high-warmth-low-competence outgroups where warmth decreased. In the competitive failure stage, warmth decreased and competence increased for all outgroup types: high-warmth-high-competence, low-warmth-high-competence, high-warmth-low-competence, and low-warmth-low-competence.

3.3 Experiment 4: Cooperative Context

Unlike Experiment 3, Experiment 4 aims to explore the evolution of warmth and competence evaluations of outgroup members with different stereotype content combinations (high warmth-high competence, low warmth-high competence, high warmth-low competence, low warmth-low competence) across four different situations in a cooperative context: initial contact, learning of cooperative intentions, cooperative success, and cooperative failure.

3.3.1 Participants

The study recruited 128 undergraduate students from a university in Wuhan, including 48 males and 80 females, with a mean age of 21.60 years (SD = [value missing]).

3.3.2 Experimental Design

The same experimental design as Experiment 3 was used, with the dependent variable being participants' warmth and competence evaluation scores for outgroup members across the four situational stages (initial contact, learning of cooperative intentions, cooperative success, cooperative failure).

3.3.3 Experimental Materials

The materials were identical to those in Experiment 3, with the only difference being that the competitive context was replaced with a cooperative context.

3.3.4 Experimental Procedure

The procedure was identical to Experiment 2.

3.3.5 Results Analysis

(1) Manipulation Check Results Manipulation checks were conducted by calculating mean trait evaluation scores for warmth and competence dimensions during initial contact: high warmth-high competence combination (M_{high} warmth = 5.53, SD = 1.48; M_{high} competence = 5.85, SD = 1.30); low warmth-high competence combination (M_{low} warmth = 2.51, SD = 1.47;

M_{high} competence = 5.51, SD = 1.29); low warmth-low competence combination (M_{low} warmth = 2.82, SD = 1.59; M_{low} competence = 2.83, SD = 1.45); high warmth-low competence combination (M_{high} warmth = 5.68, SD = 1.19; M_{high} competence = 3.36, SD = 1.46). Independent samples t-tests against the scale midpoint (4) revealed significant differences (ps < 0.001), confirming the effectiveness of the paradigm.

(2) Descriptive Statistics Results In the cooperative context, descriptive statistics for warmth and competence perceptions of outgroup members with different stereotype content (high warmth, low warmth, high competence, low competence) across the four situational stages (initial contact, learning of intentions, task success, task failure) are presented in Table 4 .

(3) Warmth and Competence Evaluations of Outgroups with Different Stereotype Content Across Four Cooperative Situational Stages A three-factor within-subjects design was conducted: 4 (situation) × 4 (target) × 2 (dimension). The results, shown in Figure 4 [Figure 4: see original paper], revealed a significant three-way interaction, $F(9, 1143) = 22.48$, $p < 0.001$, $p^2 = 0.15$. All main effects and two-way interactions were significant ($p < 0.001$), except for the situation × dimension interaction ($p = 0.32$). Following the same analytic approach as Experiment 1, we examined partial interactions for success and failure conditions separately.

In the "success" condition (ignoring the "failure" level), the three-way interaction was significant, $F(6, 122) = 15.86$, $p < 0.001$, $p^2 = 0.44$. To examine how warmth and competence evaluations changed continuously across situations, we treated situation as a continuous variable and conducted trend analyses to investigate how the linear change trend was moderated by dimension and target.

First, the overall linear trend across situations was highly significant, $F(1, 127) = 138.94$, $p < 0.001$, $p^2 = 0.52$, as was the quadratic trend, though the effect was relatively weaker [$F(1, 127) = 11.39$, $p = 0.001$, $p^2 = 0.082$]. Linear analysis revealed a significant three-way interaction, $F(3, 125) = 27.90$, $p < 0.001$, $p^2 = 0.40$, indicating that the linear trend of ratings across situations was significantly moderated by evaluation dimension and target. Examining simple interaction effects from the target perspective revealed significant simple interactions only when evaluating low-warmth-high-competence [$F(1, 127) = 53.75$, $p < 0.001$, $p^2 = 0.30$] and high-warmth-low-competence targets [$F(1, 127) = 59.64$, $p < 0.001$, $p^2 = 0.32$], but not for high-warmth-high-competence [$F(1, 127) = 0.14$, $p = 0.71$] or low-warmth-low-competence conditions [$F(1, 127) = 2.01$, $p = 0.16$]. Further examination of these simple interactions revealed that when evaluating low-warmth-high-competence targets, both warmth [$F(1, 127) = 97.24$, $p < 0.001$, $p^2 = 0.43$] and competence dimensions [$F(1, 127) = 15.63$, $p < 0.001$, $p^2 = 0.11$] showed significant linear trends, though the strength of situational linear effects differed significantly. Warmth ratings showed a relatively pronounced linear increase as cooperation progressed to success, while

changes on the competence dimension were more gradual. When evaluating high-warmth-low-competence targets, only the competence dimension was significant [$F(1, 127) = 83.71$, $p < 0.001$, $p^2 = 0.40$], with competence ratings showing a clear linear increase during cooperation, while the effect of different cooperation stages on warmth was not significant [$F(1, 127) = 1.28$, $p = 0.26$].

In the "failure" condition (ignoring the "success" level), the three-way interaction was significant, $F(6, 122) = 16.06$, $p < 0.001$, $p^2 = 0.44$. To examine how warmth and competence evaluations changed continuously across situations, we treated situation as a continuous variable and conducted trend analyses to investigate how the linear change trend was moderated by dimension and target.

First, the overall linear trend across situations was significant, $F(1, 127) = 31.424$, $p < 0.001$, $p^2 = 0.20$, as was the quadratic trend, with a relatively stronger effect [$F(1, 127) = 66.78$, $p < 0.001$, $p^2 = 0.35$]. Therefore, we focused on the quadratic trend.

Quadratic analysis revealed a significant three-way interaction, $F(3, 125) = 285.96$, $p < 0.001$, $p^2 = 0.87$, indicating that the quadratic trend of ratings across situations was significantly moderated by evaluation dimension and target. Further examination from the target perspective revealed that only when evaluating high-warmth-low-competence outgroups was there a simple interaction between dimension and situation [$F(1, 127) = 18.50$, $p < 0.001$, $p^2 = 0.13$]. In other words, for the other three outgroup types, participants' evaluations on both competence and warmth dimensions showed a first-increase-then-decrease trend as cooperation progressed.

For the significant simple interaction observed when evaluating high-warmth-low-competence outgroups, further examination of simple simple effects revealed that the quadratic trend of warmth ratings across cooperative situations was only marginally significant [$F(1, 127) = 3.28$, $p = 0.07$, $p^2 = 0.03$], while the quadratic trend for competence ratings was highly significant [$F(1, 127) = 50.69$, $p < 0.001$, $p^2 = 0.29$].

3.3.6 Discussion

From the warmth and competence evaluation trends for outgroup members with different stereotype content across the four cooperative situations based on dual-dimension information presentation, we can see that during the evaluative intention stage—when informed about impending cooperation with the outgroup—people showed increases in both warmth and competence for high-warmth-high-competence and high-warmth-low-competence outgroups. During the outcome evaluation stage—when imagining success and failure outcomes after cooperating with the outgroup—consistent with single-dimension results, cooperative success led to increases in both warmth and competence for all outgroup types: high-warmth-high-competence, low-warmth-high-competence, high-warmth-low-competence, and low-warmth-low-competence. Similarly, unlike competitive failure, cooperative failure led to decreases in both warmth and

competence for all outgroup types.

4.1 Positive and Negative Relationships Between Warmth and Competence in Intergroup Evaluation

Summarizing the results from Study 1 (single-dimension information presentation) and Study 2 (dual-dimension information presentation) (see Table 5), we can see that the single-dimension results from Study 1 and the dual-dimension results from Study 2 show similarities. Specifically, people' s evaluations of single-dimension high-warmth outgroups were similar to evaluations of dual-dimension high-warmth-high-competence outgroups; evaluations of low-warmth outgroups were similar to low-warmth-low-competence outgroups; evaluations of high-competence outgroups were similar to high-competence-low-warmth outgroups; and evaluations of low-competence outgroups were similar to low-competence-high-warmth outgroups. This finding provides a new perspective on the relationship between warmth and competence. Previous research has shown that warmth and competence may have a positive relationship, such as the halo effect, where high scores on one dimension correspond to high scores on the other (Yzerbyt, Kervyn, & Judd, 2008; Holoien & Fiske, 2013). Other research has demonstrated negative relationships, such as compensation effects, where perceivers compensate in opposite directions on the other dimension when they detect differences between social targets on one dimension, creating contrast (Kervyn et al., 2009; Kervyn et al., 2011; Zuo et al., 2014). The current finding that high-warmth results align with high-warmth-high-competence, and low-warmth with low-warmth-low-competence, indicates that when inferring competence from known warmth, a halo-effect positive relationship indeed exists. Conversely, the alignment of high-competence with high-competence-low-warmth, and low-competence with low-competence-high-warmth, indicates that when inferring warmth from known competence, a compensation-effect negative relationship exists. This discovery provides new directions and evidence for exploring the warmth-competence relationship.

4.2 Influence of Evaluative Intentions on the Evolution of Warmth and Competence Perceptions in Intergroup Evaluation

The research demonstrates that when participants are informed they will interact with outgroups varying in warmth and competence—that is, when they learn of interaction intentions—their perceptions of outgroups show consistent patterns (see Table 5). Specifically, evaluations of low-warmth and low-warmth-low-competence outgroups showed increasing trends on both warmth and competence dimensions. Evaluations of low-competence and low-competence-high-warmth outgroups showed decreasing warmth and increasing competence. Evaluations of high-warmth and high-warmth-high-competence outgroups showed decreasing warmth and overall increasing competence. Evaluations of high-

competence and high-competence-low-warmth outgroups showed overall increasing warmth and decreasing competence. Overall, during the stage of learning about outgroup intentions, regardless of whether in competitive or cooperative contexts, people tend to shift their evaluations in directions opposite to their prior perceptions of outgroup warmth and competence (except for competence evaluations of high-warmth and high-warmth-high-competence targets in cooperative contexts, where although an increasing trend was observed, the difference was minimal). This "centralizing" or balancing tendency in warmth and competence evaluations upon learning of outgroup intentions is independent of cooperative versus competitive context. This result aligns with evolutionary adaptive survival mechanisms underlying the two-dimensional cognition of warmth and competence. As Fiske, Cuddy, Glick, and Xu (2002) proposed: "When social animals encounter conspecifics, they must first determine whether others are friends or foes (warmth judgment), and then assess whether others have the capability to implement their intentions (competence judgment)" (Zuo et al., 2015). Thus, when participants learn they will interact with outgroup members, they unconsciously adopt a defensive posture, lowering warmth evaluations of high-warmth outgroups and raising competence evaluations of low-competence outgroups. This helps people avoid being misled by friendly intentions from high-warmth outgroups and prevents them from letting down their guard against potential threats from low-competence outgroups. Simultaneously, this pattern reflects adaptive interaction psychology: increasing warmth evaluations of low-warmth outgroups helps reduce intergroup hostility and facilitates better intergroup interaction.

4.3 Influence of Success/Failure Outcomes on the Evolution of Warmth and Competence Perceptions in Intergroup Evaluation

Both Study 1 and Study 2, from single-dimension and dual-dimension perspectives, found that the influence of success/failure outcomes on the evolution of warmth and competence perceptions is constrained by situational context. As shown in Table 5, in competitive success, evaluations of all outgroup members showed a warmth-increasing, competence-decreasing trend—that is, an inverse change between warmth and competence (except for warmth evaluations of low-competence-high-warmth outgroups, which decreased). In competitive failure, evaluations of all outgroup members showed a warmth-decreasing, competence-increasing trend, also representing an inverse relationship. In cooperative success, evaluations of all outgroup members showed increases in both warmth and competence—that is, parallel changes between the dimensions. In cooperative failure, evaluations of all outgroup members showed decreases in both warmth and competence, also representing parallel changes. These results align with the previously mentioned ontological and functional explanations of warmth and competence (Abele et al., 2014). From a functional and pragmatic perspective, the influence of post-action outcomes on evaluations of outgroup warmth

and competence primarily reflects considerations for the healthy development of the intergroup relational system. After competitive or cooperative successes and failures, people weigh self-interested and affiliative needs, and their warmth and competence evaluations of outgroups reflect this psychological mechanism to some extent.

4.4 Limitations and Future Directions

This research examined people' s warmth and competence evaluations of outgroups in competitive and cooperative contexts, exploring the evolutionary trends across pre-action evaluative intention stages and post-action success/failure outcome stages. It expands existing research in the intergroup relations domain and the Stereotype Content Model, holding important theoretical and practical significance. As an initial exploration, this research has several limitations and shortcomings that warrant further investigation and refinement in future studies.

First, this research used the Distant Planetary Paradigm to create virtual outgroups with varying warmth and competence levels. This method can exclude confounds from pre-existing beliefs about real groups, enabling better causal inference (Cuddy, Fiske, & Glick, 2007), and our manipulation checks verified the paradigm' s effectiveness. However, it is important to recognize that while the virtual group paradigm has unique advantages, it also has certain limitations, such as potentially reduced ecological validity. Future research should select more real groups with varying levels and combinations of warmth and competence, testing these effects in real-world cooperative and competitive contexts.

Second, this research focused primarily on cooperative and competitive contexts, exploring the relationship between warmth and competence inferences and the differential patterns and regularities of warmth and competence perception dependency on contexts before and after actions. These findings await replication in other contexts, such as social contexts matched to warmth (e.g., tourism) and work contexts matched to competence (e.g., academic discussions). Additionally, according to the Behaviors from Intergroup Affect and Stereotypes Map (BIAS Map), emotions play an important role in intergroup evaluation (Bye & Herrebrøden, 2017). Examining the role of emotional reactions toward outgroups across different contexts represents an important direction for future research.

Finally, it is worth considering whether the phenomenon of "one rising while the other falls" in competitive contexts and "rising and falling together" in cooperative contexts discovered in this research is an inevitable derivative of the Stereotype Content Model, or whether it reflects content constructed within unique psychological patterns of Chinese culture. Investigating this question will be an important direction for future research. In Chinese culture, which emphasizes long-term harmonious relationships, using "virtue and talent"(where "virtue" corresponds to warmth and "talent" to competence) for interpersonal

evaluation is a common phenomenon. Does this create the "rising and falling together" pattern in cooperative contexts? Combining the competitive "one rising while the other falls" and cooperative "rising and falling together" phenomena with content from Chinese cultural psychology and conducting cross-cultural comparative research to more deeply reveal the internal cultural foundations of situational evolution of warmth and competence in intergroup evaluation represents an important future research direction.

Conclusions

(1) Research from both single-dimension and dual-dimension information presentation perspectives shows that the alignment of high-warmth with high-warmth-high-competence and low-warmth with low-warmth-low-competence indicates a halo-effect positive relationship when inferring competence from known warmth. The alignment of high-competence with high-competence-low-warmth and low-competence with low-competence-high-warmth indicates a compensation-effect negative relationship when inferring warmth from known competence.

(2) The influence of evaluative intentions on warmth and competence evaluations of outgroup members is independent of specific situational contexts. Overall, people' s warmth and competence evaluations of outgroup members exhibit a "centralizing" or balancing tendency upon learning of interaction intentions, consistent with evolutionary adaptive survival mechanisms underlying warmth and competence cognition.

(3) The influence of success/failure outcomes on warmth and competence evaluations of outgroup members is constrained by situational context. In competitive contexts, warmth and competence evaluations exhibit an inverse evolutionary pattern of "one rising while the other falls." In cooperative contexts, warmth and competence evaluations exhibit a parallel pattern of "rising and falling together."

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Note: Figure translations are in progress. See original paper for figures.