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Focusing on the positive or the negative: Self-construal moderates negativity bias in impression updating

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Abstract

Negativity bias refers to the phenomenon whereby people put more weight on negative information. Although evolutionarily favorable for survival, negative bias in impression processing is detrimental to relationships and cooperation. To explore whether the motivation to maintain relationships, indicated by self-construal, mitigates negativity bias, two studies were conducted. In study 1, participants interacted with three agents (worsened, improved, baseline) in a modified social learning task and evaluated the moral level of these agents. Results showed that positivity bias appeared among interdependent individuals, with larger updating for the improved agent than for the worsened agent. Moreover, interdependent individuals exhibited less immediate decreases toward the worsened agent and steeper increases toward the improved agent than did independent individuals. To validate the results of study 1, we used a narrative description paradigm in study 2. Participants read the behavior descriptions of agents and rated them on morality. The negativity bias was significantly mitigated among individuals with high interdependence, though it did not reverse. These results indicate that interdependent individuals focus more on positive information when others change, yielding a more positive pattern in impression updating. This flexible interpersonal coping strategy can bring advantages to social interaction and cooperation.

KEYWORDS
impression updating, negativity bias, self-construal

INTRODUCTION

Accurate moral judgment about others is important in navigating social life. In this ever-changing world, we need to update our impressions of others frequently. For example, we may change our view if a stingy coworker unexpectedly helps us or if a close friend turns us down when we are in need. However, people show negativity bias in impression updating, which is detrimental to social relationships. An interesting question is whether the negativity bias manifests interindividual differences; that is, whether this bias disappears or even reverses for some individuals. Clarifying this question is important for understanding interpersonal interactions and explaining individual differences in interpersonal relationships. In the present research, we intend to test how self-construal, which defines people's emphasis on relationships, impacts impression updating.

Compared with positive stimuli, negative stimuli play a more powerful role in attention, emotion, and memory, which is advantageous for survival (Baumeister et al., 2001; Hamlin et al., 2010; Johnson & Tierney, 2018; Kensinger & Corkin, 2003; Schupp et al., 2004; Wentura et al., 2000). This effect is known as negativity bias. This bias is also common in interpersonal judgment. According to previous studies, negative information has a greater impact when an impression is being formed (Skowronski & Carlston, 1989) and when the impression is being changed: immoral behaviors outweigh moral ones in impression updating. Specifically, people show greater updates when others change from moral to immoral behavior, compared with the reverse (Mende-Siedlecki et al., 2013; Mende-Siedlecki & Todorov, 2016). The weight people place on negative information about others may be of evolutionary significance (Johnson et al., 2013; Öhman et al., 2001), because the timely detection of the bad intentions of others can help people to avoid being taken advantage of (Vaish et al., 2008), which is adapted for survival.

However, updating impressions blindly based on limited negative information sometimes yields suboptimal social decisions and even damages social relationships. For instance,

people may unfairly judge a good partner as having a low level of morality when presented with new negative information. This may obstruct reciprocity, which is the foundation for cooperation (Nowak, 2006), and eventually result in the loss of mutual benefits and in damage to social relationships (Johnson et al., 2013; Kim et al., 2020). Empirical research has indicated that focusing more on the negative information has a detrimental impact on relationships (Carstensen et al., 1995; Siegel et al., 2020; Vorauer & Sucharyna, 2013). Instead, focusing less on negative social information or more on positive information in impression updating would be beneficial in social life. Some evolutionary thinkers have proposed a similar viewpoint: responding to bad behaviors with probabilistic cooperation is a better choice to deal with an uncertain world, and this pattern is called "generous tit-for-tat" (Nowak & Sigmund, 1992). Evidence from evolutionary models finds that "generous tit-for-tat" is preferable to strategies that arbitrarily end cooperative relationships after a single betrayal (Fudenberg et al., 2012; Rand et al., 2009). That is, some people forgive occasional bad behaviors for the sake of maintaining relationships and future cooperation. Following this perspective, Crockett et al. (2021) prosed a relational logic for moral inference in a review: people form and update moral impressions in ways that are responsive to the demands of ongoing social relationships, and update impressions in a way that promotes cooperation. Under this theoretical construction, negativity bias in impression updating, which may harm relationships, should be reduced among people who emphasize social relationships. As self-construal is the most typical construct used in defining emphasis on relationships, its influence on impression updating is well worth studying, which should add implications to theories of moral cognition.

Self-construal refers to how people process separation from and connectedness with others (Markus & Kitayama, 1991). People who are dominated by independent self-construal perceive others as distinct from the self. They favor actions that allow the expression of self-defining and unique attributes. Those who are dominated by interdependent self-construal, however, view others as related to the self. They are concerned with fitting into the group and attach importance to proper social relationships. Compared with independent individuals, interdependent individuals place more emphasis on harmonious relationships with others (Cross et al., 2011; Markus & Kitayama, 1991; Singelis, 1994) and are more willing to make an effort to get close to others (Markus & Kitayama, 1991). For example, interdependent individuals prefer to use the facial expressions of other people in the group to infer the emotion of the target (Masuda et al., 2008), prefer cooperative strategies (Komissarouk & Nadler, 2014; Oetzel, 1998), and exhibit a stronger prosocial tendency (Moscardino et al., 2020). These features reflect their sensitivity to interpersonal relationships and their propensity to maintain them.

We argue that because people with higher interdependent self-construal emphasize harmonious social relationships, they may show more forgiveness or tolerance when others do something less moral or less considerate than usual. For example, interdependent people might focus less on the negative information from a social target when this target is changing, and thus they may show reduced negativity bias in impression updating, or even show positivity bias. Independent individuals, however, with their weaker focus on harmonious relationships and a tendency to directly express attitudes, may update the impression more heavily when the social agent worsens, and they may be less motivated to update the impression when the social agent improves. Therefore, compared with interdependent individuals, independent ones could show a more negative pattern of impression updating.

Some prior empirical evidence supports the inference above. Interdependent individuals can better dispel negative stimuli in interpersonal interactions. Research has shown that interdependent individuals are more resilient in coping with social exclusion (Pfundmair, Aydin, et al., 2015; Pfundmair, Graupmann, et al., 2015). They indicate lesser antisocial behaviors after being excluded. This resilience may reduce negativity bias in impression updating by similarly buffering the negative experience during interactions. In addition, some research has uncovered the influence of interdependence on impression processing. Individuals with higher interdependence levels tend to develop more positive impressions of targets in photos (Milyavskaya et al., 2010) or based on others' faces (Meng et al., 2022). It can be concluded from these studies that interdependent individuals are inclined to hold a positive view about others. It is unclear, however, whether, when the social target worsens, interdependent individuals will still tend to maintain a positive impression. One study gives some insight into this issue. Park and Young (2020) found that when participants' own interests are compromised by a target, participants with a larger scale of friendship update their impression of an out-group target more than that of an in-group one. Researchers have concluded that this result reveals the significance of motivation for maintaining relationships on impression updating. If this conclusion holds, interdependent individuals who emphasize relationships would also show reduced negativity bias. However, as pointed out by researchers, studies that directly measure motivation in maintaining relationship and test its effect on impression updating are still lacking (Park et al., 2021).

Furthermore, in impression perception, there is a considerable lack of research on the influence of the perceiver's characteristics compared with the amount of research on the characteristics of the perceived target (Hehman et al., 2017; Mattarozzi et al., 2015). This problem also exists in research regarding impression updating. However, these two sources (i.e., the perceiver and the perceived target) are equally important, and understanding the contribution of them both is critical to understanding the process of interpersonal impression (Hehman et al., 2017; Meng et al., 2022). Exploring the effect of how people view relationships on impression updating would help to fill the gap in research on the sources of perceiver characteristics, so as to enhancing our understanding of moral cognition.

We used two valid paradigms to explore the effect of self-construal on impression updating. In study 1, we used a modified version of the social learning task (Siegel et al., 2018), which is a rigorous experimental paradigm with high ecological

validity. Participants formed and updated impressions through interactions with the programmed agents. The behavior sequence of each agent was well matched to ensure that the levels of bad and good agents were symmetrical around the average (Siegel et al., 2018). Therefore, in this paradigm, an impression was developed based on well-controlled and adequate information. Moreover, this paradigm allows the dynamics of impressions across time to be assessed, which was captured by the discontinuous growth model (DGM), a method suitable for calculating the effect of change (Singer et al., 2003). By using the sub-divided time components of the DGM, we can trace the sources of the updating bias in terms of time and attain a deeper understanding about inter-individual difference in impression updating that found from linear mixed effects models (LMMs). In study 2, we used a narrative description paradigm to further confirm the results of study 1, which is a typical paradigm used in research about impression updating (Kim et al., 2020; Mende-Siedlecki et al., 2013; Mende-Siedlecki & Todorov, 2016).

We predicted that individuals of higher accessible interdependent (independent) self-construal may exhibit a more positive (negative) updating pattern. That is, individuals who place importance on social relationships would be less influenced by negative social information, and thus the negativity updating bias could be reduced or even reversed among them.

STUDY 1

Method

Participants

Sixty-one students participated in the study, but two were excluded because they failed to follow the instructions to complete the experiment. The final sample size was 59 individuals, aged 19–29 years ($M = 21$ years, $SD = 2.46$), 40 females. According to LaHuis and Ferguson (2009), to ensure adequate power to detect a small cross-level interaction when using a multilevel random coefficient model, the sample size of level 2 should be at least 50 and that of level 1 at least 10 per cell. We met this recommendation through 25 morality ratings nested in 59 participants, yielding 1475 observations. We started with random recruitment and found a serious imbalance in the independence and interdependence ratio after reaching 46 people; finally, 13 participants were recruited only when their interdependence–independence difference index (IIDI) was higher than zero. All participants provided written consent. This study was approved by the Committee for Protecting Human and Animal Subjects in the School of the Psychological and Cognitive Sciences, Peking University.

Procedures

Participants were told that there were two roles in the task. In each trial, those in role A received 20 CNY (3.13 USD) while those in role B received a 20-s electric shock by default; A could decide whether to reduce the shock time of B by spending a given amount out of the 20 CNY. If A chose to help, their income would be reduced and B would suffer a shorter shock. For example, as shown in Figure 1, by choosing to help, A would spend 5 CNY to reduced by 15 s shock of B. If A refused to help, A kept all the money, and B suffered the full 20 s. Participants were previously told that only five trials would be randomly selected and actually implemented. A would receive the corresponding money for these trials, and B would receive shocks for the corresponding time when the experiment ended. The study consisted of three phases: titrating the pain of the shock, playing role B, and playing role A. However, only the second phase was relevant to the purpose of the study. That is, participants predicted and received feedback about A's decisions, so as to form an impression about A. Participants were told that the agents were other participants who had participated in this experiment earlier. In the third phase, participants played role A, and this phase was used to mimic reality by convincing participants that the decisions of A in the second phase were made by real people.

Phase 1: pain titration

After attaching two electrodes to the back of the participant's left hand, we delivered shocks with a Digitimer DS7 stimulator. Participants rated their subjective feelings of pain on an 8-point scale (1 = *not painful*, 8 = *intolerable*). We began at a low voltage, and increased by 1 mA each time. The titration stopped when participants' ratings reached 7, and they were told the shock would be delivered at that strength when implementing the chosen trials.

Phase 2: playing role B

Participants interacted with three agents, and then a computer displayed 50 decisions from each agent. At the beginning of each interaction sequence, the participant was presented with a blurred picture of the agent, who shared the same physiological gender as the participant. For each trial in the sequence, participants were shown the amount of money that A was required to spend and the shock time that could be reduced with that money. Participants were asked to predict the decision of the agent, and then received feedback on accuracy, forming an impression gradually (Figure 1). Participants rated moral impressions of the target every two trials, based on all the information available up to the present trial, on a 9-point scale (1 = *nasty*, 9 = *nice*). After each impression rating, participants indicated how uncertain they felt about the rating, again on a 9-point scale (1 = *very certain*, 9 = *very uncertain*). The parameter κ indicated the agents' "harm aversion," which was the subjective trade-off between money and others' pain, ranging from 0 (profit maximizing) to 1 (pain minimizing) (Siegel et al., 2018). The higher the κ is, the more harm-averse the agent is. This parameter has been proved to be capable of capturing individual differences in moral decision-making and is related to prosocial behaviors, empathy, and psychopathy (Siegel et al., 2018; Crockett et al., 2014). The research has shown that participants rate a good agent (agent characterized by high κ) significantly higher than a bad agent (agent

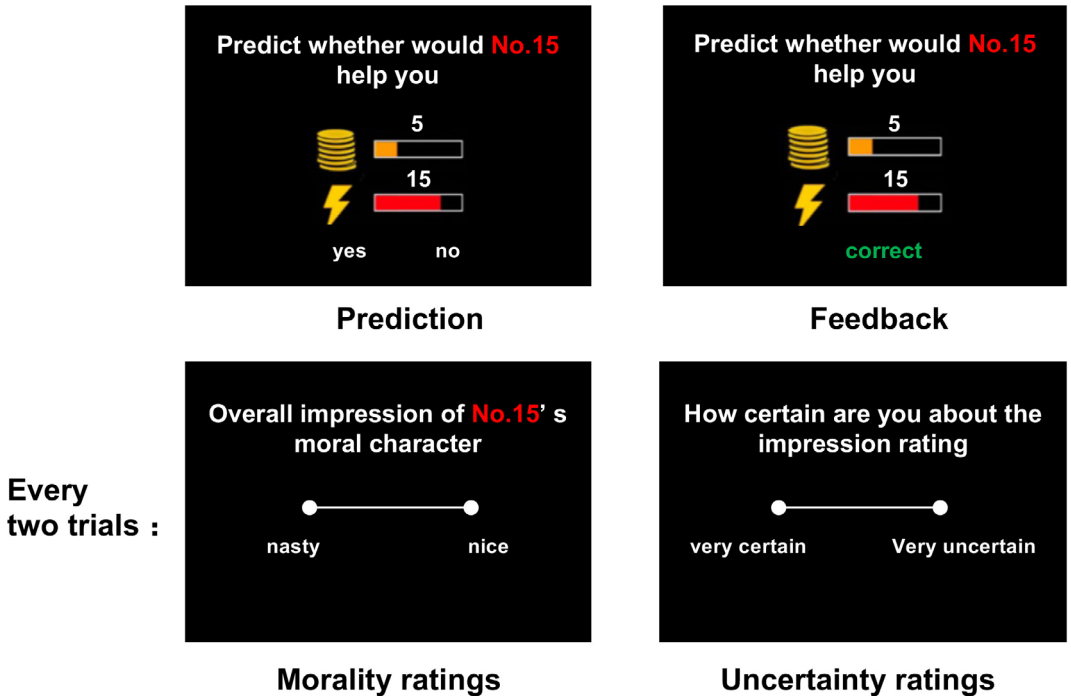

FIGURE 1 Example trial. Upper panels, participants made a prediction and received feedback for a series of decisions of worsened, improved, and baseline agents; lower panels, morality and uncertainty were rated every two trials.

characterized by low *K*) on morality. We used this parameter to characterize the agents as good or bad ($K = 0.8$ for a good agent, 0.2 for a bad agent, and 0.5 for a baseline agent). This meant that a good agent would choose to help when the unit price for the shock was below 4 CNY (for details of the calculation, see Data S1) and refuse to help when the unit price was above 4 CNY. Similarly, these values for a bad agent and a baseline agent were 0.25 CNY and 1 CNY. However, the decision criteria of two agents changed after the 32nd trial. The good agent worsened, with a decreasing κ, and the bad agent improved, with an increasing κ, both reaching 0.5. This ensured that the change in magnitude of the decision criteria was the same for good and bad agents. The decision criteria of the baseline agent remained at $\kappa = 0.5$ throughout.

Phase 3: playing role A

Participants were told that they would play role A, and could decide whether to help others reduce shock time. That is, participants made a decision about whether to spend money to help others by reducing the shock time. Because phase 3 was not related to the purpose of our study, participants only played six trials and we did not analyze data in this phase.

Finally, participants filled out the Self-Construal Scale (Singelis, 1994) and demographic variables. Twelve items measured independent self-construal (e.g., I enjoy being unique and different from others in many ways; $\alpha = 0.821$). The other 12 items measured interdependent self-construal (e.g., I usually sacrifice my self-interest for the benefit of my group; $\alpha = 0.725$). Participants answered all items on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*). Following the practice of prior research, we defined the accessibility of self-construal as IIDI, which was calculated as the average of the interdependence scale minus the average of the independence scale (Liu et al., 2018; Ma et al., 2014; Tu et al., 2021). Thus, higher scores indicate a more accessible interdependent self-construal relative to independent self-construal. We also analyzed the data using an interdependence subscale, which indicated similar conclusions (for details see Data S1).

LMM analysis

We conducted linear mixed effects models in R with the package *lme4* (Bates et al., 2014), according to the guidance of Brauer and Curtin (2018). Prior research used the average of all of the ratings (three ratings in total) after the transition point and the average of the final three ratings before the transition point to calculate impression-updating magnitude (Siegel et al., 2018). Following this practice, we used all of the ratings after the transition point and the same number of ratings before the transition point to calculate the updating magnitude. In this way, we can use the data as fully as possible in order to minimize the error associated with sampling. Therefore, in our research, impression updating was calculated by subtracting the average of nine post-switch ratings from that of nine pre-switch ratings for the worsened agent, and subtracting the average of 9 pre-switch ratings from that of 9 post-switch ratings for the improved agent. We also calculated the updating magnitude in a three-trial case and five-trial case, with the analysis showing similar results (see details in Data S1).

With LMM, we regressed impression updating on updating direction (positive to negative vs. negative to positive), IIDI (mean-centered), and the interaction of updating direction × IIDI. In our study, multiple participants responded to the same set of agents; that is to say, participants were sources of nonindependence in the data (Brauer & Curtin, 2018). However, to simplify the model and avoid overparameterization, we only included by-subject random intercept (and did not include the random slope). Excluding the random slope would neither affect the estimation of the fixed slope nor increase the type I error rate in our study because there is only one within-participant predictor in the model (Barr et al., 2013). We used the *Anova* function in the *car* package to estimate *F*, error *df* (via Kenward–Roger approximation), and *p*. We used the *simple_slopes* function to test simple effect when an interaction was significant. Specifically, the association between direction and impression updating were tested for low (1 *SD* below the mean) and high (1 *SD* above the mean) levels of interdependence. We used the *confint.merMod* function to calculate confidence intervals. We also analyzed the uncertainty ratings with reference to a previous study (Siegel et al., 2018). See Data S1 for the results.

DGM analysis

We retained all observations in analysis (rather than taking mean values) with the DGM, a variant of multilevel mixed-effects model (Singer et al., 2003), to inspect specifically how interdependent self-construal affected impression across the whole updating process. The DGM is widely used in research exploring the effect of changes in environmental and experimental conditions (Devaraj & Jiang, 2019; Fulmer & Gelfand, 2015; Howe, 2019). It is useful for capturing multitrial, time-dependent changes, which can help to clarify the details of the updating process. Using the sub-divided time components of DGM, we can trace the sources of the updating bias in terms of time and attain a deeper understanding about inter-individual differences in impression update than found with LMM. The LMM results provide rough information about the overall impression update, while the DGM helps to identify the time-varying features of impression update. We coded the time parameters according to the recommendations of Bliese et al. (2020) (Table S1). In the DGM, time is subdivided into three components, which are TIME·A, TRANS, and POST. TIME·A calculates the linear rating trajectory (i.e., slope) before the agent changes. TRANS captures the immediate rating transition when the agent changes. POST calculates the linear rating trajectory (i.e., slope) after the agent changes. The term TIME·A is coded as absolute time, which is used when the factor causing the initial slope is removed and changes into another condition (Bliese & Lang, 2016).

Analyses were conducted with the nonlinear and linear mixed-effect model package (*nlme*) in R (Pinheiro et al., 2018). We followed the strategies described in previous research (Bliese et al., 2020). Briefly, there were four steps. First, we calculated the intraclass correlation coefficient (ICC) with the null model to indicate how much of the total variance can be attributed to differences within or between individuals (higher-level entity), and whether to bring random effects into the model. Second, we determined whether the slopes of the time parameters varied randomly among individuals by comparing models with and without time parameters as random variables. This step identified where the inter-individual variance were located. Third, we tested whether within-individual error structures (autocorrelation and heteroscedasticity) existed and controlled for them. Fourth, by including IIDI as the individual predictor, we tested the interaction between IIDI and the time parameter and explained differences between individuals.

Results

Examining the manipulation

Before calculating the updating scores, we preliminarily used the impression ratings as the dependent variable to directly inspect how the impression ratings frustrate across the trials. Specifically, 18 impression ratings around the transition point were divided into six phases (nine ratings before the transition point and nine ratings after the transition point), and each phase had three ratings. Then we took the average of the three ratings in each phase. Next, using the rating as the independent variable, we conducted a 3 (agents: worsened, improved, baseline) × 6 (phase: from 1 to 6) repeated-measured analysis of variance (ANOVA). The results showed that the effect of agents was significant, $F_{(2,102)} = 151.686$, $p < .001$, $\eta_p^2 = 0.748$. Bonferroni adjustment was used for multiple comparisons. The impression ratings for the worsened agent were significantly higher than those for the improved agent ($M_{worsened} = 7.012$, $SE = 0.138$; $M_{improved} = 4.300$, $SE = 0.162$; $t(57) = 17.842$, $p < .001$) and the baseline agent ($M_{baseline} = 6.007$, $SE = 0.167$; $t(57) = 7.564$, $p < .001$). Furthermore, the impression ratings for the improved agent were significantly lower than those for the baseline agent ($t[57] = -11.006$, $p < .001$). Impression ratings significantly increased across these 6 phases, $F_{(3.313,\ 168.980)} = 4.380$, $p = .001$, $\eta_p^2 = 0.079$, and the interaction between agent and phase was significant, $F_{(3.957,\ 201.809)} = 43.375$, $p < .001$, $\eta_p^2 = 0.460$. For both the worsened and the improved agent, differences between phase 3 and phase 4 were significant (Worsened: $M_{phase\ 3} = 7.469$, $SE = 0.138$, $M_{phase\ 4} = 6.853$, $SE = 0.179$, $t[57] = 5.176$, $p < .001$; Improved: $M_{phase\ 3} = 3.565$, $SE = 0.218$, $M_{phase\ 4} = 4.819$, $SE = 0.199$, $t[57] = -6.778$, $p < .001$), while those for baseline agent were not ($M_{phase\ 3} = 5.977$, $SE = 0.173$, $M_{phase\ 4} = 6.062$, $SE = -1.269$, $p < .001$). The ratings in phase 2 and phase 3 before the change did not differ for all agents ($ps > .05$). These results support the validity of our manipulation. That is, participants did rate agents of different moral levels differently, and the ratings reached a stable level before the transition point. In addition, the manipulation of transition of the agents' behaviors did cause the impression ratings to change (Figure 2).

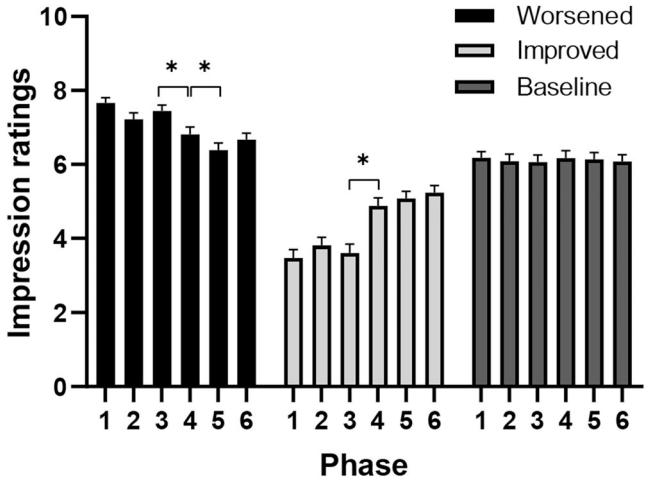

FIGURE 2 Impression ratings in phases before (1–3) and after (4–6) the change for the agents. *$p < .05$; error bars represent 1 SEM.

LMM analysis results

LMM was conducted to examine the effect of direction, IIDI and their interaction on impression updating. The equation is shown in Table 1. The Akaike information criterion (AIC) of the model was 351.11. IIDI negatively predicted updating magnitude, $b = -0.351$, $F_{(1,\ 104.85)} = 4.328$, $p = .040$. There was a main effect of direction, $b = 0.507$, $F_{(1,57)} = 9.593$, $p = .003$. Impression for the improved agent was updated to a greater extent than that for the worsened. Importantly, the effect of direction on impression updating was moderated by IIDI, $b = 0.653$, $F_{(1,56)} = 9.593$, $p = .003$. Simple effect analysis was conducted to further determine how participants with diverse IIDI updated impression differently. Participants with a low IIDI did not show any updating bias ($M_{\text{worsened}} = 1.041$, $SD = 0.901$; $M_{\text{improved}} = 1.212$, $SD = 1.031$; $b = -0.029$, $t[56] = -0.123$, $p = .903$); in contrast, participants with a high IIDI manifested positivity bias, increasing their ratings to a greater extent when the agent improved rather than worsened ($M_{\text{worsened}} = 0.713$, $SD = 0.903$; $M_{\text{improved}} = 1.568$, $SD = 1.413$; $b = 1.043$, $t[56] = 4.500$, $p < .001$) (Figure 3). That is to say, interdependent individuals engaged in more positive updating than negative updating.

DGM analysis results

DGM was conducted to capture the details of the updating process. The equations can be found in Tables 2 and 3. We first fitted a DGM with the ratings of the worsened agent. The ICC was 0.43; that is, 43% of the total variance was associated with between-individual differences. This indicates that moral ratings vary both within and between individuals, and thus random effect should be calculated. –2log-likelihood tests showed that the overall fit improved when sequentially including the random effect of TIME.A, TRANS, and POST (Table S2). Then, we controlled for autocorrelation because it was significant (−2log-likelihood ratio = 38.60, $p < .001$). We included IIDI as a predictor to determine how it impacted the updating process. The results showed that individuals of low interdependence decreased the ratings more at the immediately after the agent worsened (TRANS × IIDI, $b = 0.339$, $t = 2.303$, $p = .021$) (Figure 4). However, IIDI did not impact the later decreasing trajectory (POST × IIDI, $b = 0.003$, $t = 0.112$, $p = .911$) (Table 2).

For the model of the improved agent, the ICC was 0.38. Tests indicated that including TIME.A and TRANS as random parameters improved the model fit (Table S2). Actually, the absence of a significant variance of POST does not preclude testing for its cross-level interaction (Snijders & Bosker, 2011). We still set up an interaction term between POST and IIDI, in addition to TIME.A and TRANS. We controlled for the significance of autocorrelation and heteroscedasticity (−2log-likelihood ratio = 40.654, $p < .001$; −2log-likelihood ratio = 31.698, $p < .001$). Then we tested the influence of IIDI on the updating process. The results showed that IIDI did not affect the immediate reaction after the agent changed (TRANS × IIDI, $b = 0.171$, $t = 0.729$, $p = .466$) (Table 3, Figure 4). For the later trajectory, however, individuals with a high IIDI showed a steeper increasing slope (POST × IIDI, $b = 0.044$, $t = 1.883$, $p = .060$), indicating a more sustained growth of impression. However, this effect did not reach the level of .05. We consider that this is acceptable, because sometimes a one-tailed test is used for cross-level interaction (e.g., Yeo & Neal, 2004; Niessen & Jimmieson, 2016; Richels et al., 2020; Niessen & Lang, 2021) since the power to detect cross-level interactions is low in multilevel analysis (Snijders & Bosker, 2011).

Correlation between negative index and IIDI

In order to uncover the relation between self-construal and the impression updating pattern more directly, we created a negative index to assess the negative tendency of impression update by subtracting participants' positive update from the negative update. Thus, higher scores indicate a more negative update pattern. Then, we calculated the correlation coefficient between negative index and IIDI index. We found that IIDI was negatively associated with the negative index ($r[59] = -0.397$, $p = .002$). That is to say, participants with a higher accessible interdependent self-construal showed a less negative updating pattern than those with a lower accessible interdependent self-construal.

Discussion

In study 1, we found that individuals with a greater accessibility to an interdependent self-construal exhibited a positivity bias in impression updating. Additionally, our results indicated that the IIDI was negatively correlated with the negative index of updating. Furthermore, the results of the DGM revealed that individuals with greater accessibility to an interdependent

TABLE 1 Linear Mixed Effects Model Results for Self-Construal, Direction and Interaction in Study 1

Fixed effects	Estimate	*SE*	95% CI	*F*	*p*
Intercept	0.880	0.138	0.611, 1.148	40.653	.000
IIDI	−0.351	0.169	−0.678, −0.023	4.328	.040
Direction	0.507	0.164	0.187, 0.828	9.593	.003
IIDI × Direction	0.653	0.200	0.262, 1.045	10.667	.002
Random effects			**Variance**		***SD***
Participant (Intercept)			0.332		0.576
Residual			0.791		0.890

Note: Model equation: update ~ direction * IIDI + (1 | participant).
Abbreviation: CI = confidence interval; IIDI = interdependence–independence difference index.

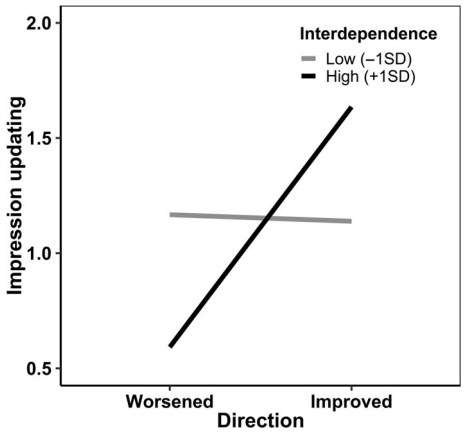

FIGURE 3 The interaction of direction with the interdependence–independence difference index (IIDI). The *y* axis presents fitted values from the linear mixed effects model; the *x* axis presents the two levels of direction.

TABLE 2 Discontinuous Growth Model Parameter Estimates of Self-Construal on Morality Ratings for the Worsened Agent.

Fixed effects	Estimate	*SE*	*df*	*t*	*p*
Level-1 model					
Intercept	7.011	0.160	1410	43.886	.000
TIME·A	0.034	0.010	1410	3.388	.001
TRANS	−0.765	0.126	1410	−6.069	.000
POST	−0.047	0.024	1410	−1.950	.051
Level-2 model					
Intercept	7.011	0.160	1407	43.804	.000
TIME·A	0.034	0.010	1407	3.301	.001
TRANS	−0.765	0.120	1407	−6.348	.000
POST	−0.047	0.024	1407	−1.970	.049
IIDI	0.187	0.196	57	0.958	.342
TIME·A × IIDI	−0.005	0.013	1407	−0.386	.700
TRANS × IIDI	0.339	0.147	1407	2.303	.021
POST × IIDI	0.003	0.029	1407	0.112	.911

Random effects	Variance	*SD*	Correlation		
1. Intercept	1.207	1.099	1	2	3
2. TIME·A	0.002	0.049	−0.434		
3. TRANS	0.145	0.381	0.180	0.648	
4. POST	0.013	0.113	−0.792	0.492	−.265

Abbreviation: CI = confidence interval; IIDI = interdependence–independence difference index.

self-construal exhibited a less immediate decline in evaluation when the agent's behavior worsened and a stronger upward trend in evaluation in the later stage when the agent's behavior improved. These findings suggest that there were individual differences in the specific updating process. In sum, these findings suggest that an individual's needs or motivations in interpersonal relationships can contribute to the valence bias in impression updating, and they highlight the importance of considering the characteristics of the perceivers in future studies. To further explore the generalizability of our findings, we conducted study 2 using a different paradigm. Specifically, participants were asked to imagine the agents acting out a certain set of behaviors.

STUDY 2

Study 2 aimed to confirm the results of study 1 with a narrative description paradigm. This is the most commonly used paradigm in impression updating (e.g., Kim et al., 2021; Mende-Siedlecki et al., 2013) and manipulates impression updating by presenting inconsistent behavioral descriptions. Given that this topic has not been directly studied in previous research, the results of study 1 might be insufficient to support our hypothesis. To validate the results in study 1 more comprehensively, it would be beneficial to derive more evidence through different but also valid paradigms. Compared with the social learning paradigm, the narrative description paradigm uses more semantically rich stimuli (i.e., behavioral descriptions of specific actions), which are easier to understand and manipulate. Study 2 was an online study with a larger sample than study 1. If the findings generalize to this task in study 2, it would further support the hypothesis that relational motivation influences impression updating and enhance the foundation for future in-depth research. We did not use DGM in study 2 because there were fewer observations of ratings from each participant and therefore the power to detect cross-level

TABLE 3 Discontinuous Growth Model Parameter Estimates of Self-Construal on Morality Ratings for the Improved Agent.

Fixed effects	Estimate	*SE*	*df*	*t*	*p*
Level-1 model					
Intercept	3.682	0.167	1398	22.081	.000
TIME·A	−0.003	0.015	1398	−0.217	.828
TRANS	1.105	0.194	1398	5.694	.000
POST	0.063	0.019	1398	3.251	.001
Level-2 model					
Intercept	3.683	0.168	1395	21.921	.000
TIME·A	−0.003	0.015	1395	−0.221	.825
TRANS	1.106	0.192	1395	5.755	.000
POST	0.063	0.019	1395	3.266	.001
IIDI	−0.076	0.205	57	−0.368	.714
TIME·A × IIDI	−0.004	0.018	1395	−0.239	.811
TRANS × IIDI	0.171	0.235	1395	0.729	.466
POST × IIDI	0.044	0.023	1395	1.883	.060

Random effects	Estimate	*SD*	Correlation	
1. Intercept	1.117	1.057	1	2
2. TIME·A	0.007	0.084	0.045	
3. TRANS	1.370	1.170	−0.478	−0.526

Note: Model equation: update ~ (TIME.A + TRANS + POST) * IIDI, random = ~ TIME.A + TRANS | participant, correlation = corAR1(), weights = varExp(form = ~ TIME.A), control = list(opt = "optim").
Abbreviation: CI = confidence interval; IIDI = interdependence–independence difference index.

interaction would be low (LaHuis & Ferguson, 2009). We predicted that results of study 2 would replicate those of study 1, namely that individuals of higher accessibility to interdependence will exhibit weaker negativity bias or even positivity bias.

Method

Participants

We recruited 250 participants via an online survey platform, *naodao* (Chen et al., 2023) (www.naodao.com). The program was customized-written with *PsychoPy 3* (Peirce et al., 2019). Nineteen participants failed one of three attention checks embedded at the end of the task or in the questionnaire, and therefore we removed their data from analysis. The final set included 231 participants (104 females), aged 18–48 years ($M = 24$ years, $SD = 5.44$). All participants were native Chinese speakers, 81.6% were undergraduates, 10.8% were graduates, and the rest of them had less than an undergraduate degree. Each participant rated six good, six bad and six baseline agents, yielding 2772 valid observations (observations in the baseline condition were not included in the model). All participants read and acknowledged the online version of the informed consent form. The study was approved by the Committee for Protecting Human and Animal Subjects in the School of the Psychological and Cognitive Sciences, Peking University.

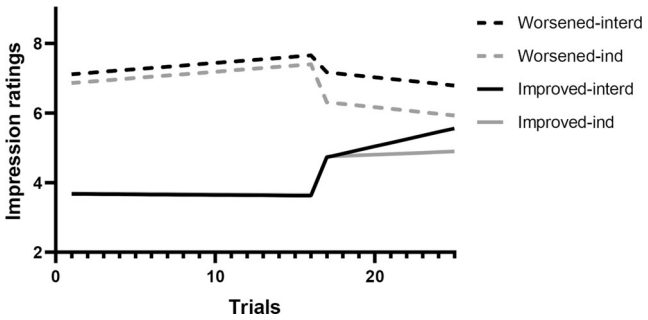

FIGURE 4 Model-based predicted values of morality ratings. Prediction of the ratings used a grand mean of the interdependence–independence difference index (IIDI) score plus or minus 1 SD for interdependent and independent individuals.

Materials and procedure

Based on the scores of moral relevance, 166 behavior descriptions that are highly relevat to morality were selected from a database of sentences describing social behaviors compiled by Mende-Siedlecki and colleagues (http://www.mendesiedleckilab.com/stimuli). We translated these descriptions into Chinese and modified the expressions to suit the Chinese context. A further 40 descriptions were collected online in the pilot study, giving 206 descriptions in total (e.g., Held the doors to the subway for an elderly woman with a walker). Forty-one participants (22 females), aged 18–28 years ($M = 22$ years, $SD = 2.99$) were recruited to rate these descriptions on four dimensions: moral relevance, emotional arousal, perceived frequency, valence (positive/negative). According to the means and variances of the ratings on the four dimensions, we chose 90 (45 moral, 45 immoral) behavior descriptions. The ratings of these descriptions were within three standard deviations around the grand mean of the dimension, and the variance on each dimension was relatively small. Then these descriptions were randomly selected to form 18 sets, with each set including five behavior descriptions. Three moral sets and three immoral sets were assigned to six baseline agents. Six sets were assigned to the worsened agents, and each included three moral and two immoral descriptions. The remaining six sets were assigned to the improved agents, and each included three immoral and two moral descriptions. The moral behaviors assigned to worsened agents did not differ from those assigned to improved agents on all dimensions (moral relevance, $F_{(1, 30)} = 0.193$, $p = .664$; emotional arousal, $F_{(1, 30)} = 0.121$, $p = .731$; perceived frequency, $F_{(1, 30)} = 1.614$, $p = .214$; valence $F_{(1, 30)} = 0.042$, $p = .840$). Likewise, the immoral behaviors assigned to the worsened agents did not differ from those assigned to the improved agents on all dimensions (moral relevance, $F_{(1, 30)} = 0.400$, $p = .532$; emotional arousal, $F_{(1, 30)} = 1.613$, $p = .117$; perceived frequency, $F_{(1, 30)} = 0.712$, $p = .406$; valence $F_{(1, 30)} = 0.121$, $p = .730$). The Self-Construal Scale used in study 2 was the same as in study 1. To create an IIDI, we subtracted the average of the independence scale from the average of the interdependence scale (Liu et al., 2018; Ma et al., 2014;

Tu et al., 2021). Higher scores indicate a more accessible interdependent self-construal relative to independent self-construal. The reliabilities of the independence and interdependence subscale were 0.721 and 0.789, respectively.

Participants were told that they would be watching the behaviors of 18 agents on the computer. Based on the behaviors, they needed to form impressions about the agents and rate them. Each agent was paired with a sequence of five behavior descriptions. Each trial presented one description on the screen. Participants were asked to imagine the agents actually acting the behaviors. After each behavior had been presented, participants were instructed to rate the agent on trustworthiness with a nine-point scale (1 = *least trustworthy*, 9 = *most trustworthy*), based on all the information they had at present. There were four types of agents: six worsened agents (good-to-bad), six improved agents (bad-to-good), three remain-good agents and three remain-bad agents (baseline). They differed in update direction. Worsened agents changed from negative to positive (three moral behaviors followed by two immoral behaviors); Improved agents changed from positive to negative (three immoral followed by two moral behaviors); baseline agents remained good (five moral behaviors) or remained bad (five immoral behaviors) through the behavioral sequences. Participants were encouraged to pay equal attention to each agent, regardless of how the agents changed. The presented order of the 18 agents was randomized. After participants had rated all of agents, they were instructed to fill in the questionnaires and demographic variables.

Results

LMM analysis and results

As in study 1, we conducted LMM in R. Impression updating was calculated by subtracting the average rating for the two post-change behaviors from that of the three pre-change behaviors for the improved agent, and the direction of this subtraction was reversed for the worsened agent (Mende-Siedlecki et al., 2013). With LMM, we regressed impression updating on updating direction (positive to negative vs. negative to positive), interdependence (mean-centered), and their interaction. Because in study 2 both participants and agents were sources of nonindependence in the data, we included by-subject and by-item random intercepts. Therefore, our model included three fixed factors and two random factors. We used the *Anova* function to estimate *F*, error *df* and *p*, the *simple_slopes* function to test simple effect, and the *confint.merMod* function to calculate confidence intervals.

The LMM equation of study 2 is shown in Table 4. The AIC of the model was 9645.40. There was no main effect of IIDI or direction in study 2, $b = -0.062$, $F_{(1,\ 240.17)} = 0.071$, $p = .790$; $b = -0.161$ $F_{(1,\ 10)} = 0.859$ $p = .376$. But, importantly, the same as the result in study 1, the effect of direction on impression updating was found to be moderated by IIDI, $b = 0.200$, $F_{(1,\ 2518.00)} = 7.248$, $p = .007$. Simple effect analysis showed that participants with a lower IIDI score showed negative updating bias ($M_{worsened} = 4.298$, $SD = 2.338$; $M_{improved} = 4.030$, $SD = 2.524$), $b = -0.283$, $t(2585) = -4.308$, $p < .001$; for participants with a higher IIDI score, the negativity bias disappeared, showing no impression updating difference between the worsened and the improved agent ($M_{worsened} = 4.333$, $SD = 2.342$; $M_{improved} = 4.295$, $SD = 2.408$), $b = -0.039$, $t(2585) = -0.598$, $p = .550$ (Table 4, Figure 5). In other words, negativity bias was reduced to no bias among individuals of more accessible to interdependent self-construal, indicating a less negative updating pattern.

Correlation between negative index and IIDI

As in study 1, we calculated the correlation coefficient between the negative and IIDI index to examine the relation between self-construal and the impression updating pattern. The result was consistent with study 1: the IIDI was negatively associated with negative index ($r[230] = -0.156$, $p = .018$). Although the results of simple effect analysis in study 1 did not replicate those in study 2, the negative index was negatively related to IIDI in both studies, which indicates that interdependent self-construal reduced negative tendency in impression updating.

Discussion

Study 2 provided a conceptual replication of study 1. The findings of study 2 were consistent with those of study 1, as the IIDI was negatively correlated with the negative index of updating. That is, in both the interaction-based paradigm and the description-based paradigm, the motivation to maintain relationships affects impression updating, supporting the relational logic in moral inference from the perspective of individual differences (Crockett et al., 2021). However, it is worth noting that there were some differences between the two studies. Specifically, study 1 revealed that individuals with higher interdependence had a positivity bias, whereas in study 2, those with lower interdependence showed a negativity bias. This difference may be due to the differences between the two paradigms, which will be elaborated in greater detail in the general discussion.

GENERAL DISCUSSION

We investigated how perceivers' accessibility to interdependent self-construal exerts an influence on impression updating with two valid paradigms. The interaction between updating direction and accessibility to interdependence was significant in both studies, suggesting that accessibility to interdependence buffered the negativity bias in impression updating. Though the simple effects of updating direction for different levels of interdependence are inconsistent in the two studies, we still found a consistent pattern. That is, there was a negative correlation between accessibility to interdependence and the negative index in both studies, which indicated that the updating pattern of interdependent individuals is more positive than that

TABLE 4 Linear Mixed Effects Model Results for Self-Construal, Direction and Interaction in Study 2.

Fixed effects	Estimate	*SE*	95% CI	*F*	*p*
Intercept	4.153	0.184	3.956, 4.672	547.139	.000
IIDI	−0.062	0.232	−0.516, 0.392	0.071	.790
Direction	−0.161	0.174	−0.511, 0.189	0.859	.376
IIDI × Direction	0.200	0.074	0.054, 0.345	7.248	.007
Random effects			**Variance**		***SD***
Participant (Intercept)			4.343		2.084
Items (Intercept)			0.085		0.291
Residual			1.411		1.188

Note: Model equation: update ~ direction * IIDI + (1 | participant) + (1 | items).
Abbreviation: CI = confidence interval; IIDI = interdependence–independence difference index.

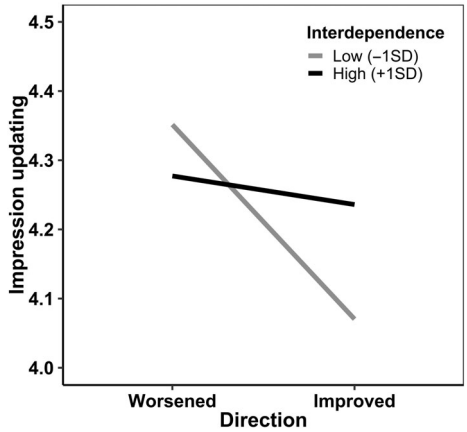

FIGURE 5 The interaction of direction with the interdependence–independence difference index (IIDI). The *y* axis presents fitted values from the linear mixed effects model; the *x* axis presents the two conditions for change of direction.

of independent ones. Given the results of LMM, we also used DGM in study 1 to examine the updating process further. The results revealed that individuals of high interdependence showed a smaller immediate decrease after the agent worsened and a steeper increase during the later process after the agent improved. In sum, the results confirmed our hypotheses, indicating that an emphasis on social connection and relationships mitigates negativity bias in impression updating. Below we will discuss the implications, limitations, and future direction of our studies.

It is interesting to discover a reduced negative tendency or even positivity bias among interdependent individuals, in the context that negativity bias is widely found in the research on moral impression updating (Kim et al., 2021; Mende-Siedlecki et al., 2013; Mende-Siedlecki & Todorov, 2016; Siegel et al., 2018). We argue that the goals of maintaining a social network and close connections with others drives interdependent individuals to keep their good opinions of others. Keeping good opinions requires mitigating the negative impact of bad events and emphasizing the positive impact of good events, leading to positivity bias. In contrast, independent individuals focus more on personal attitude and less on relationships, so they may be less motivated to discount negative information. Therefore, a typical negative updating tendency could be mitigated, as also shown by the result that when accessibility of interdependent self-construal increased, the updating negative index decreased. This result highlights the significance of relationship motivation on interpersonal judgment.

Our results in study 1 showed an overall positivity bias that was the exact opposite of the negativity bias. In study 2, negativity bias was also not found. We propose that the inconsistency between our research and previous literature is due to the inconsistent cultural contexts. Previous research that found negativity bias was conducted in Western cultural contexts, whereas, to our knowledge, the present study is the first to examine impression updating in an Eastern cultural context. On the one hand, it is likely that the dominance of the interdependent self-construal in Eastern culture plays a role. Although in the present study, we can define participants as of interdependent or independent tendency according to the centered IIDI, the majority of participants in the Eastern cultural context should have a propensity for an interdependent mindset (Markus & Kitayama, 1991; Oyserman et al., 2002). Therefore, it is likely that the positivity bias in study 1 emerged because most of the subjects are essentially of interdependent self-construal, even though we tried to balance the number of participants with interdependent and independent self-construal during the recruitment. On the other hand, cognitive style could be one cultural factor that contributed to the overall positive tendency in the present research. There is considerable evidence showing that people from Eastern societies tend to think more holistically (Kitayama et al., 2009; Nisbett et al., 2001). Holistic thinkers focus more on external environmental factors as determinants of behavior, while analytic thinkers tend to focus on the attributes of the object itself (Miller, 1984; Nisbett et al., 2001). Previous research has shown that, because they make external attributions, participants who are presented with negative information about a brand which they used to be positive about update their impressions toward the product to a lesser extent (Monga & John, 2008, 2010). Likewise, because they consider contextual factors, participants are likely to attribute negative transitions

to external sources (external attribution) rather than to the agents themselves (internal attribution), leading to a further reduction in negativity bias. However, how holistic thinking affects positive and negative updates simultaneously in interpersonal judgment remains to be studied.

Furthermore, we argue that the inconsistency of the results between study 1 and study 2 could be due to the difference in the paradigms' settings. First, in study 1, participants believed that they were interacting with the agents, while participants in study 2 just imagined the agents acting certain behaviors, which should lead to different levels of involvement. Subjects in study 1 thought that they were interacting with real people who had come to the laboratory, and this sense of authenticity could make them feel the social connection more strongly. As such, they may be motivated to protect the relationship to a greater degree. However, participants knew that the behavioral descriptions they read did not truly tale place in study 2, and that it was impossible to meet the agents. Moreover, when the moral situation is personally relevant, participants have stronger emotional experiences, and emotion-related brain areas are activated to a greater extent (Greene et al., 2001). Thus, in study 1, the realistic experiences may have further enhanced the positive tendency of updating (positive updating outweighs negative updating) for most participants, based on their emphasis on social connections in an Eastern context. Second, an overall positivity bias was found in study 1. This could also lead to the inconsistency of the two studies in the simple effect of direction for different individuals. Finally, study 1 involved behaviors in various social situations (e.g., Held the doors to the subway for an elderly woman with a walker; Laughed at a question asked by a classmate), whereas study 2 was a decision game involving the trade-off of money and electric shocks. Perhaps the range of extremity of morality was broader in study 1 than in study 2, which may result in inconsistent updating patterns (Skowronski & Carlston, 1989), but this should not prevent us from exploring individual differences. Though the results of studies 1 and 2 were not entirely consistent, the interdependent accessibility reduced the overall negative pattern of updating, which was indexed by subtracting positive updating from negative updating.

Prior research has shown that people are biased in their perception toward in-group members in order to protect positive impressions about other members (Brewer, 1999; Monroe & Malle, 2019). Conversely, people discount ratings about out-group people to a greater extent when negative information is presented (Hughes et al., 2017; Park & Young, 2020). This is referred to as motivated cognition (Hughes & Zaki, 2015; Kim et al., 2020; Lemay & Clark, 2015). Specifically, to reach a desired conclusion, individuals can selectively process supported and unsupported evidence, search memory in line with the conclusion, and interpret the events in the orientation consistent with their belief (Kunda, 1990). Therefore, people may produce auxiliary hypotheses to facilitate their desired belief about the targets according to social distances or relationships. In fact, in impression updating, ideas of motivated cognition and relational logic are subject to the similar theoretical treatment. Both perspectives stress that people's cognition is affected by levels of relational demands. Yet a detail needs to be noted. The present research focused on individual differences in the value placed on social relationships and did not manipulate different social relationships. In particular, our research provides support for these perspectives in terms of individual differences. If different relationships generate different levels of demands, and thus affect impression updating, then individual differences in demands of maintaining relationships should also have an effect.

In fact, impression processing could in turn affect interpersonal relationships. Researchers have pointed out that the difficulties with interpersonal relationships in borderline personality disorder can be attributed to the tendency to hold rigid negative impressions of others (Siegel et al., 2020). The more attention is paid to negative events, the more damage is done to relationships. As the cycle repeats, cooperation could be broken (Johnson et al., 2013; McCullough, 2008). To maintain cooperation in an always changing world, it may be better to preserve cooperative opportunities even in the face of the misbehaviors of the target (Nowak & Sigmund, 1992). This is called "generous tit-for-tat," denoting the attempt to maintain cooperation after betrayal. This lenient strategy is more successful in evolutionary models than the retaliatory strategy (Fudenberg et al., 2012). Positivity bias echoes this strategy. That is, trying to forgive negative behaviors and keeping a relatively good impression of the target can ultimately increase the willingness to cooperate and improve the likelihood of successful cooperation. As noted by Kim et al. (2020) in a review, discounting negative information may help social relationships to be maintained, which can promote future social and material benefits. Moreover, mitigation for negative information helps us to understand the mechanism of prosocial tendency among interdependent individuals (Cross et al., 2011; Moscardino et al., 2020). A potential process is that interdependent individuals boost a friendly first impression (Meng et al., 2022) and try to sustain it in the presence of inconsistent information, and are thus more willing to help others. Our research provides support for the proposition that responding to negative behaviors with leniency is adaptive for healthy social functioning (Crockett et al., 2021).

Our research fills the gap regarding how the perceiver's characteristics, rather than the perceived target's characteristics, impacts impression updating. The perceived object and the perceiving subject are two sources affecting interpersonal processing in social and cognitive models (Bruce & Young, 1986; Neuberg & Fiske, 1987; West & Kenny, 2011). Previous studies have revealed the effect of various characteristics of perceivers on interpersonal perception and interaction, such as gender (Ben-Ner & Halldorsson, 2010), personality (Mattarozzi et al., 2015), anxiety (Willis et al., 2013), motivation (Park & Young, 2020) and age (Castle et al., 2012). Because these studies focused mainly on the characteristics of the perceived object, we are far from clarifying how the characteristics of perceivers influence interpersonal perception and interaction. Therefore, researchers have called for an emphasis on individuals'

characteristics (Hehman et al., 2017; Xie et al., 2019). Our research has added to the topography of interpersonal perception by considering the perceivers' characteristics.

With DGM, we first revealed the time process in moral impression updating. Combining the results of the two DGMs, we refined the formation process of the different updating patterns from interdependent and independent individuals which was found in LMM. Interdependent individuals showed a less immediate impression discount for the worsened agent (indicated by TRANS × IIDI), and a faster forgiving during the later process for the improved agent (indicated by POST × IIDI). It can be concluded that the updating process for the worsened and improved agents is different between independent and interdependent individuals. The result is consistent with the research of Fulmer and Gelfand (2015). They found that collectivists were more forgiving after trust violation. However, their results also showed that when the trust violation was large, compared with a small violation, collectivists showed a faster and greater decrease of trust rating. Their results imply that our findings may stem from the mild violation of the first impression. That is, the positivity bias found among people of high interdependence might disappear if we increased the magnitude of violation. Further study should be undertaken to examine how the violation magnitude and individual differences simultaneously affect impression updating. Exploring the effect of individual characteristics on social interactions will uncover different interactive patterns and strategies, which is important for understanding social relationships (Lopes et al., 2003). We advocate more research to investigate further the formation and development process of interpersonal impression.

We acknowledge that the present studies have some limitations. First, although in both studies interdependent individuals exhibited a more positive updating than did independent individuals, the results were not exactly consistent. We suppose this is due to the variation of involvement in the experimental paradigms. Subsequent research could manipulate this factor in order to gain an in-depth understanding. Second, defining motivation for social relationship in terms of self-construal might be too broad. Future studies could examine other motivational variables such as affiliation motivation to confirm our results. Third, examining the effect of self-construal impression updating is not enough to understand the full picture of how subjective factors affect impression updating. Recent research has revealed the importance of subjective factors on impression formation (Hester et al., 2021; Meng et al., 2022), but more research is needed to explore subjective factors and their interaction with objective ones regarding impression updating, and to provide a more complete view of the mechanism underlying impression processing.

In conclusion, our research implies that individuals who emphasize social relationships, which is indicated by self-construal, have a more positive impression updating pattern. During the updating process across time, they have less immediate reactions when others worsen and forgive faster when others improve. The way people process social relationships influences moral impression updating, which highlights the significance of individual differences in impression updating and supports the relational logic of moral cognition.

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CONFLICT OF INTEREST STATEMENT

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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