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The relationship between agency, communion, and neural processes associated with conforming to social influence

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ABSTRACT

Social influence is ubiquitous in our daily lives, influencing our opinions, beliefs, and behaviors. Individual differences may determine who is most likely to conform to the opinions of others. More specifically, individual differences in interdependent and independent self-construal determine an individual's sensitivity to and focus on their social surroundings. Relatedly, society traditionally ascribes and prescribes different levels of agency (independence) and communion (interdependence) to men and women. Here, we examined how individual differences in self-construal, and their congruence with gender expectations, influence how people process and respond to social feedback. Results from independent behavioral and neuroimaging samples show that a stronger interdependent self-construal was associated with increased likelihood of conformity, whereas an independent self-construal was not. Further, neuroimaging data suggests that the relationship between brain activity and conformity is moderated by the congruence of gender stereotypes and self-construal. Specifically, stereotypically congruent women (with stronger interdependence) and men (with stronger independence) showed increased activity in mentalizing regions (and value regions in men) when conforming. Stereotypically incongruent women (with stronger independence) and men (with stronger interdependence) showed decreased mentalizing activity when conforming. These results shed light on underlying (neuro)psychological mechanisms that are associated with conformity among different groups.

1. Introduction

Social influence surrounds us daily in the form of mass communication, social media, and interpersonal communication and can have a strong impact on our opinions, attitudes, beliefs, and behaviors (Cialdini & Goldstein, 2004). Given the practical importance across a wide variety of domains and fields there is great interest in gaining further understanding of why and how people conform to social influence. One way to gain additional insight is by examining the underlying neural processes associated with conformity. Recent research has shown neural processes associated with subjective valuation (including activity in the ventral medial prefrontal cortex (vmPFC) and ventral striatum (VS)) and understanding other people's thoughts and feelings, termed mentalizing (including activity in the temporal parietal junction (TJP) and dorsal medial prefrontal cortex (dmPFC), have been associated with conformity (for reviews, see (Cascio, Scholz, & Falk, 2015b; Izuma, 2013)). Positive subjective valuation, which is closely related to reward, has been suggested as a key mechanism of conformity (Baek et al., 2021; Campbell-Meiklejohn et al., 2010; Cascio, O'Donnell, et al., 2015a; Klucharev et al., 2009; Nook & Zaki, 2015; Welborn et al., 2016; Zaki et al., 2011) because people may be more likely to pay attention to social cues if they expect (social) rewards such as increased sense of belonging or group membership for doing so. Social endorsements also make the socially popular choice or opinion seem more important to follow

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(Baumeister & Leary, 2017; Cascio, Scholz, & Falk, 2015b; Cialdini & Goldstein, 2004; Ruff & Fehr, 2014). Mentalizing may also support conformity to social feedback (Baek et al., 2021; Cascio, O'Donnell, et al., 2015a; Welborn et al., 2016). For example, if an individual realizes that their opinion is different from others, they may adjust their opinions or intentions after considering why others' opinions conflict with their own initial perception. However, less attention has been given to how individual differences may influence these processes.

Agency and communion are two dimensions used for describing and judging the self and others (Abele & Wojciszke, 2007). Agency is related to a stronger independent self-construal, with greater focus on the self and autonomy in one's thoughts and actions (Abele & Wojciszke, 2007; Markus & Kitayama, 1991). People who have strong independent self-construal tend to focus on internal attributes and promoting their own goals and use others for social comparison to reflect on themselves (Markus & Kitayama, 1991). In addition, independence motivates maintaining one's own beliefs and withstanding social pressure (Torelli, 2006). Communion, on the other hand, is related to a greater focus on social desirability and a stronger interdependent self-construal (Abele & Wojciszke, 2007) and emphasizes relationships with others, belonging, and fitting in to maintain harmony with others (Markus & Kitayama, 1991). Interdependent individuals tend to consider relevant others' opinions when making decisions (Singelis, 1994) and interdependent self-construal is associated with motivation to conform (Torelli, 2006).

The effects of self-construal on decision-making in social contexts interact with gender (Flinkenflogel et al., 2017; Russell et al., 2017), given that gender is socially constructed (Lorber & Farrell, 1991). Society traditionally ascribes and prescribes different levels of independence (agency) and interdependence (communion) to people who identify as men and women. In Western societies, men are traditionally viewed as more agentic and thus dominant, autonomous, and independent, whereas women are traditionally viewed as more communal, interdependent, cooperative, and submissive in both public and domestic spheres (Blackstone, 2003; Stets & Burke, 2000). However, the correlation between gender and self-construal tendencies is not perfect and many people do not follow the societal stereotype (i.e., independent women and interdependent men). Thus, we explore whether there are differences in how individuals with stereotypically congruent and incongruent self-construal tendencies conform to social influence.

How does congruency between identifying as a man or woman, and having an independent or interdependent self-construal, impact behavior and the neural mechanisms of conformity? Behaviorally, we would expect that women who are more interdependent will conform more often compared to men who are independent. When considering why people conform from a neural perspective, one possibility is that people who value (i.e., increased neural activity in regions associated with positive valuation) and weigh other-focused concerns (i.e., increased neural activity in regions associated with mentalizing) when conforming may be driven in part by whether individual differences in self-construal align with societally prescribed attributes (i.e., gender). If self-construal interacts with societally prescribed attributes, we expect that people who tend to value social norms more broadly will both tend to show more congruent self-construal's and show increased activation in brain regions associated with mentalizing than people whose self-views are less congruent with societal prescriptions overall. On the other hand, if self-construal does not interact with societally prescribed attributes, we would expect that independent and interdependent self-construal's will shape people's tendency to conform, as well as the neural processes supporting conformity, regardless of other identities like gender. In this case, we would expect to see greater conformity in those high in interdependent self-construal, as well as greater activity in brain regions that track other people's opinions (i.e., mentalizing, positive valuation), regardless of participant gender.

1.1. The current study

Therefore, the current study aims to expand and clarify our understanding of whether individual differences in gender and self-construal, and congruence between these dimensions in terms of societal prescriptions (i.e., independent men/interdependent women), are related to differences in neural processes associated with conformity. To this end, participants completed a conformity task in which they made decisions about mobile phone apps based on app descriptions and peer feedback as part of a behavioral study or while undergoing fMRI and provided self-report measures of self-construal (Singelis, 1994) and gender.

2. Methods

2.1. Participants

Ninety participants aged 18–31 (M = 21.71 years old, SD = 2.90 years; 61 self-identified women; 29 self-identified men) were recruited across two fMRI studies from a large East Coast university (combined in this paper as the 'fMRI participants'). Exclusion criteria are reported in supplemental materials.

In addition, 150 participants 18 years and older (M = 24.99 years old, SD = 7.68 years; 85 females) were recruited from two locations, including a large Midwest university and large East Coast university in an independent behavioral sample to examine the relationship between self-construal, gender, and individual differences in conformity.

2.2. Study design

After participants gave consent to participate in the study, they were asked to complete initial ratings for the conformity task. For fMRI participants, initial ratings were given before the fMRI brain scanning session. Next, participants completed the social feedback portion of the social influence task. fMRI participants completed this portion of the task during the brain scanning session. As a part of both studies, participants were asked to complete the self-construal scale from Singelis (1994) and gender. Details regarding the self-construal survey are reported in supplemental materials, along with individual differences in self-construal.

2.3. Social influence task

To examine conformity to social influence the current study examined ratings of mobile game apps from the App Store based on seeing the app title, logo, and a brief description. Prior to the scanning session participants rated each app based on how likely they would be to recommend the app to others (Fig. 1). Then during the scanning session participants were shown how they initially rated the app (i.e., initial rating), followed by social feedback indicating how others rated the app in comparison to the participant (i.e., lower, higher, same, or not rated). Finally, participants were told they had an opportunity to rerate the app. Conformity was defined as trials where the participant changed their initial rating in response to social feedback that others rated the app higher or lower compared to trials where the participant maintained their initial rating (Fig. 2). Full task details are reported in supplemental materials.

2.4. fMRI data acquisition and analyses

fMRI data acquisition, preprocessing, statistical modeling, and region of interest definitions for neurosynth "mentalizing" and "value" maps (Fig. 3) are reported in supplemental materials. All analyses were conducted in R (version 4.2.2) and all tables are reported in supplemental materials. In addition, exploratory analyses examining the primary subregions within the value and mentalizing ROIand exploratory

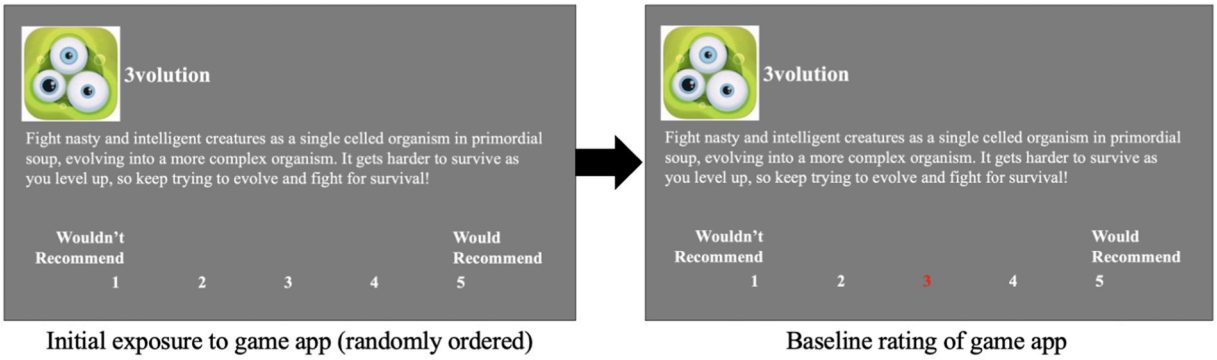

Fig. 1. Initial game app ratings. Note: Initial ratings of the game apps were collected before the scanning session. Rating were based on a 5 point scale from 1 = "wouldn't recommend" to 5 = "would recommend". Ratings were based on exposure to the game logo, title, and a brief description of the game.

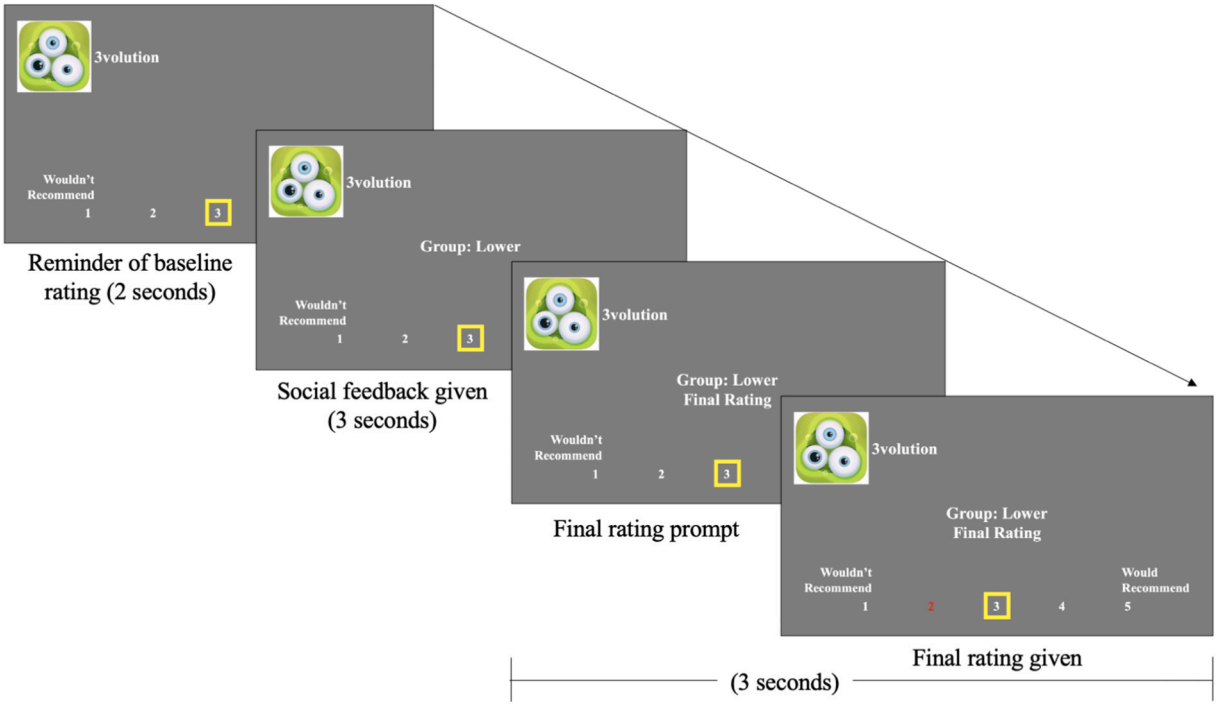

Fig. 2. fMRI social feedback ratings. Note: The social feedback (*higher*, *lower*, *same*, or *not rated*) version of the task was given during the scanning session. Rating were based on a 5 point scale from 1 = "wouldn't recommend" to 5 = "would recommend". Ratings were based on exposure to the game logo, title, and a reminder of the participant's initial rating.

whole brain analyses are reported in supplemental materials.

3. Results

3.1. Individual difference measures

3.1.1. Behavioral conformity

As a manipulation check in our fMRI sample, participants were more likely to change their initial app recommendations in response to social feedback suggesting that they were misaligned with peers compared to feedback suggesting they were aligned with peers ($t(85) = 13.67$, $p < 0.001$, $CI = [0.25, 0.34]$) and feedback suggesting the group had not yet rated the stimulus ($t(85) = 10.29$, $p < 0.001$, $CI = [0.19, 0.29]$; Table S1).

3.1.2. Self-construal differences in conformity

First, we examined whether self-construal was related to conformity in our fMRI sample. Results demonstrated that a stronger interdependent self-construal is associated with increased likelihood of conforming ($r(81) = 0.23$, $p = 0.038$), however, independent self-construal was not associated with conformity ($r(81) = -0.09$, $p = 0.418$). Gender did not moderate these relationships ($t(78) = 0.04$, $p = 0.966$, $CI = [-0.06, 0.06]$; $t(78) = -0.76$, $p = 0.448$, $CI = [-0.12, 0.05]$, respectively). Parallel findings (supplemental materials) were found in our larger independent behavioral sample ($N = 150$).

3.2. Brain region of interest analyses

3.2.1. Neural correlates of conformity, self-construal, and gender

First, we aimed to examine whether the main effect of self-construal (independent, interdependent) and gender were associated with the underlying neural processes associated when conforming to divergent social feedback versus maintaining one's own opinion. Findings indicated that independent self-construal was significantly associated with mentalizing when conforming to social feedback that participants were misaligned with peers ($t(82) = 2.21$, $p = 0.030$, $p(FDR) = 0.060$, $CI =$

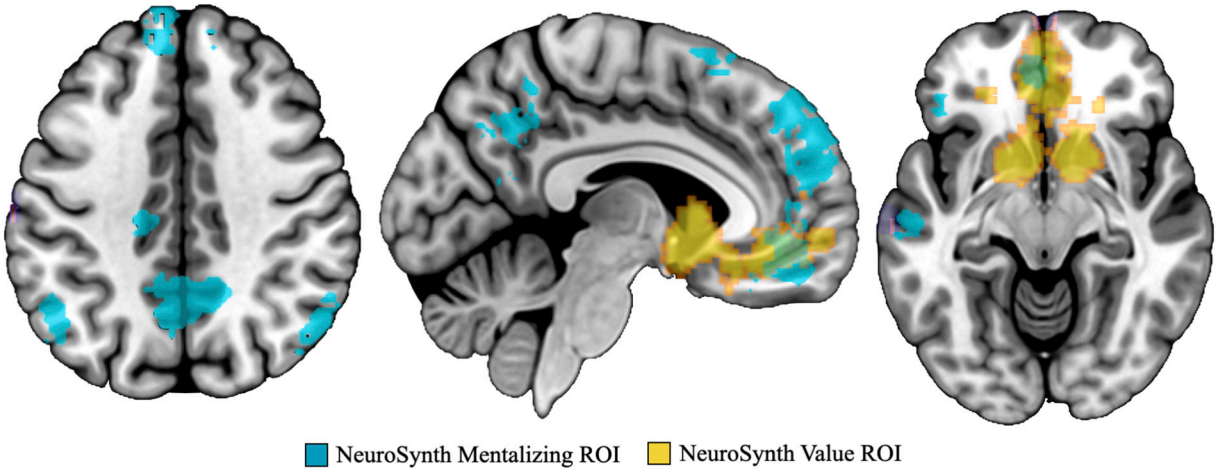

Fig. 3. Regions of interest (ROIs). Note: Functional ROIs extracted from Neurosynth using the keywords "value" and "mentalizing". The value ROI included the VS, vmPFC, and subgenual anterior cingulate. The mentalizing ROI included the dmPFC, TPJ, precuneus, posterior cingulate, supplemental motor area, vmPFC, and temporal pole.

[0.01, 0.22]), though this finding did not survive correction for multiple comparisons. No other main effects of self-construal or gender were significant, $p > 0.05$. In addition, of the four analyses examined, the main effect of study cohort was significant ($p < 0.05$) in two of our analyses and marginally significant in one analysis, such that one cohort consistently showed increased mentalizing activity in comparison to the other cohort. Thus, study cohort was controlled for in our analyses.

Next, we aimed to examine whether congruency (versus incongruency) between gender and self-construal was associated with different underlying neural processes when conforming to social influence. Significant interactions between independence and gender were significantly associated with activity in value (Fig. 4) and mentalizing regions (Fig. 5); full results are reported in Table S3. In addition, a significant interaction between interdependence and gender was associated with activity in mentalizing regions (Fig. 6) but not value regions; full results are reported in Table S4.

3.2.2. *Neural correlates of conformity and congruency between self-construal and gender*

Follow up analyses indicated that men who reported a stronger independent self-construal (i.e., stereotype congruent men) displayed significantly more activity in both mentalizing ($t(82) = 2.20$, $p = 0.031$, $p(FDR) = 0.038$, $CI = [0.02, 0.48]$) and value ($t(82) = 3.01$, $p = 0.003$, $p(FDR) = 0.006$, $CI = [0.10, 0.47]$) regions of interest during conformity vs. resist trials. However, women's levels of interdependent self-construal (i.e., stereotype congruent women) was not significantly associated with neural activity in the value and mentalizing regions ($p > 0.05$) during conformity vs. resisting conformity trials. Subregion analyses can be found in Figs. S1–S3.

3.2.3. *Neural correlates of conformity and incongruency between self-construal and gender*

Further, men who reported stronger interdependent self-construal (i.

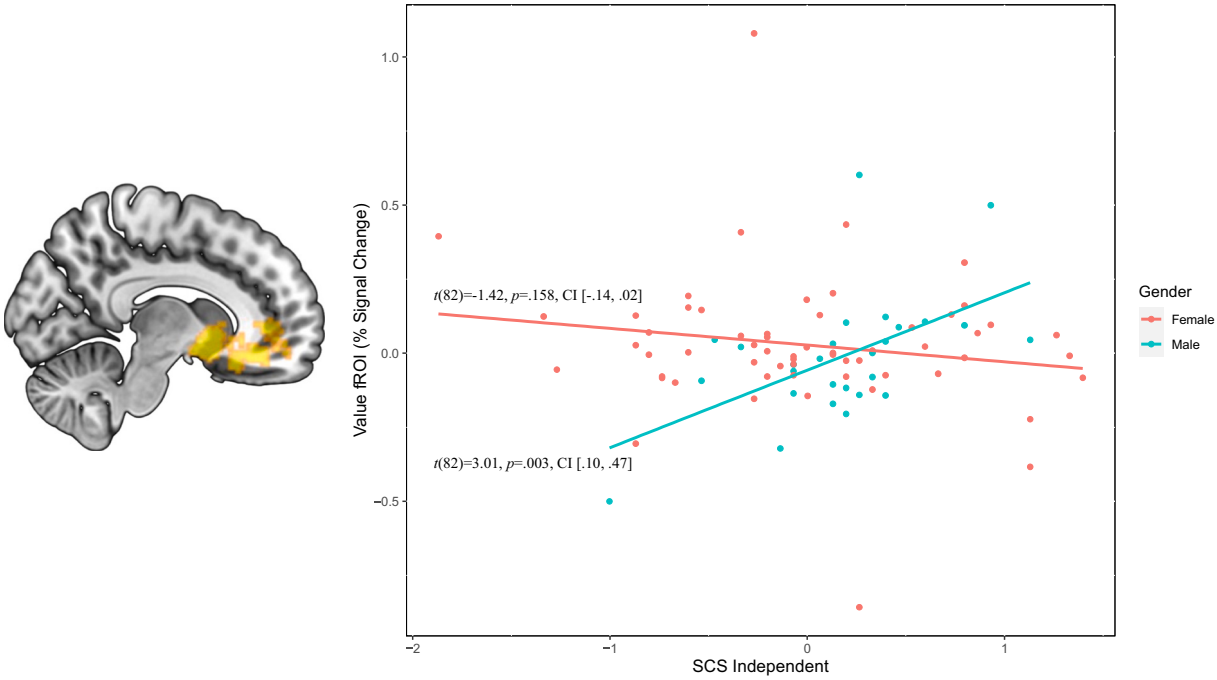

Fig. 4. Value ROI and independent self-construal by gender. *Note*: Significant interaction between gender, independent self-construal and brain regions tracking subjective value ($t(82) = 3.33$, $p = 0.001$, $p(FDR) = 0.004$, $CI = [0.07, 0.27]$).

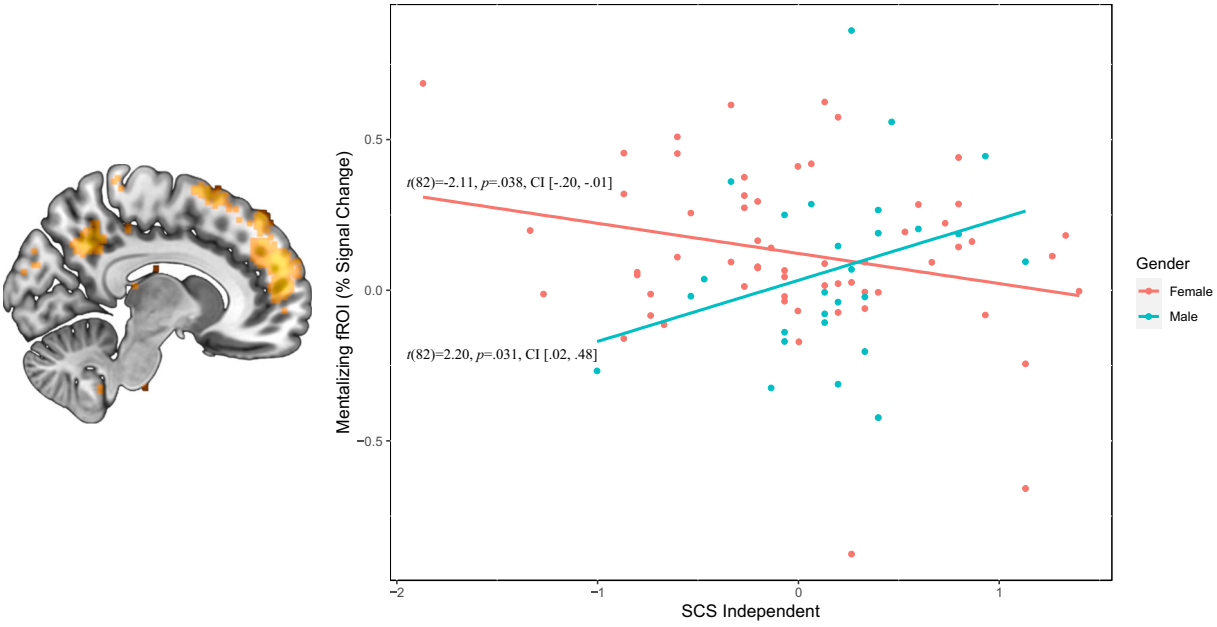

Fig. 5. Mentalizing ROI and independent self-construal by gender. *Note*: Significant interaction between gender, independent self-construal and brain regions tracking mentalizing ($t(82) = 2.85$, $p = 0.006$, $p(FDR) = 0.012$, $CI = [0.05, 0.31]$).

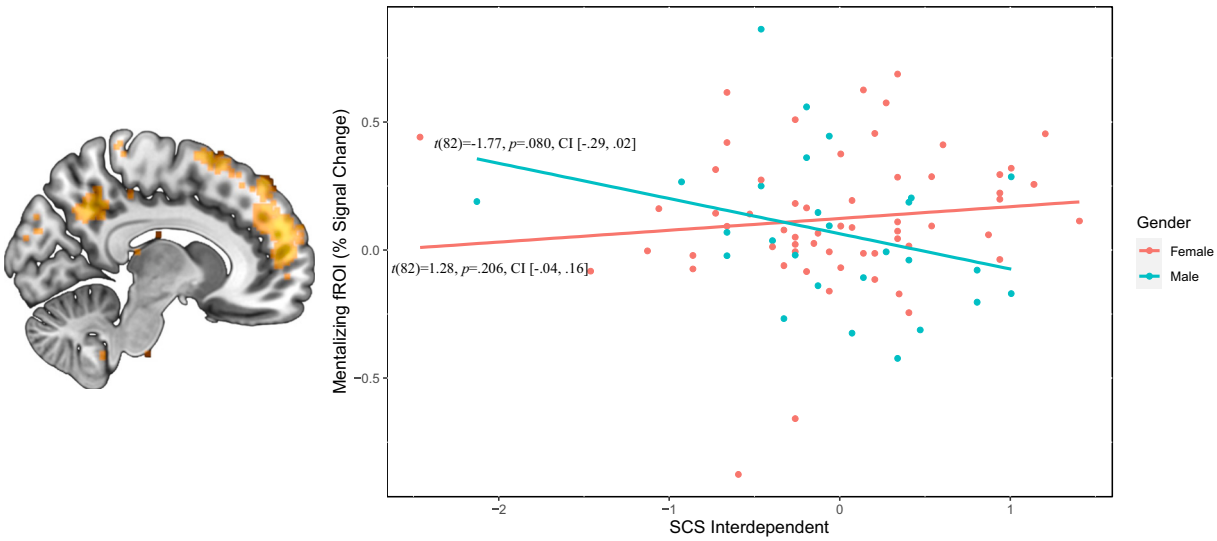

Fig. 6. Mentalizing ROI and interdependent self-construal by gender. *Note*: Significant interaction between gender, interdependent self-construal and brain regions track mentalizing ($t(82) = -2.18$, $p = 0.032$, $p(FDR) = 0.064$, $CI = [-0.19, -0.01]$).

e., stereotype incongruent men) showed marginally decreased activity in the mentalizing regions ($t(82) = -1.77$, $p = 0.080$, $p(FDR) = 0.160$, $CI = [-0.29, 0.02]$) during conformity vs. resisting conformity trials. In addition, women who have a stronger independent self-construal (i.e., stereotype incongruent women) displayed significantly less activity in the mentalizing regions ($t(82) = -2.11$, $p = 0.038$, $p(FDR) = 0.038$, $CI = [-0.20, -0.01]$) during conformity vs. resisting conformity trials. Subregion analyses can be found in Figs. S1–S3.

4. Discussion

The current study investigated whether individual differences in self-construal and gender, and their congruency (i.e., independent men; interdependent women), relate to conformity and the neural mechanisms supporting conformity. Consistent with past research (Täuber & Sassenberg, 2012; Torelli, 2006), we found that those higher in interdependence were more likely to conform to peer feedback. However, our findings also revealed that congruency between self-construal and gender norms are related to the underlying neural processes associated with conformity. Specifically, stereotype congruent participants (i.e., interdependent women and independent men) showed increased mentalizing activity during conformity, whereas stereotype incongruent participants (independent women and interdependent men) displayed decreased mentalizing activity during conformity. Thus, people whose self-construal was consistent with societal prescriptions for their gender showed increased activation in brain regions that support considering others' opinions while conforming. By contrast, people whose self-construal was inconsistent with societal prescriptions for their gender showed less activation in these regions while conforming. These results show that the mechanisms associated with conformity differ across

groups in theoretically meaningful ways.

4.1. Behavioral conformity and self-construal

First, the current study examined whether self-construal and gender were behaviorally related to individual differences in conformity. Results indicated that the stronger an individual's interdependent self-construal is, the more likely they were to conform to divergent social feedback. However, independent self-construal was not associated with individual differences in conformity, and gender did not moderate these behavioral associations between self-construal and conformity. Overall, our behavioral findings are consistent with previous literature that suggests a stronger interdependent self-construal motivates conformity - a communal behavior (Täuber & Sassenberg, 2012; Torelli, 2006).

However, where previous literature finds that a stronger independent self-construal motivates maintaining one's own opinions (Torelli, 2006), the current study found that independent self-construal was unrelated to behavioral differences in conformity, both in our fMRI sample and behavioral sample. The current study focused on individual differences in self-construal, whereas Torelli (2006) examined the use of self-construal as a prime before social feedback exposure, which may account for these differences. In addition, previous literature finds that women, in comparison to men, are more likely to conform to the opinions of others (Flinkenflogel et al., 2017), though gender differences in conformity were not significant in the current study, there was a trend in the same direction as previous literature (Flinkenflogel et al., 2017). Although previous behavioral findings reveal who is most likely to conform to social influence, they fail to illuminate what underlying processes unfold as different groups conform, even when behavioral differences are not apparent. To answer this question, we explored brain mechanisms underlying conformity.

4.2. Neural correlates of conformity and congruency between self-construal and gender

We aimed to examine whether differences in self-construal and gender were associated with neural mechanisms previously associated with conformity. Among men, having a stronger independent self-construal was significantly related to increased activity in mentalizing and positive valuation regions when they conformed to the group (compared to when they did not conform). Mentalizing activity was primarily driven by activity in the dmPFC, a region previously associated with conformity to social feedback (Cascio, 2017; Cascio, O'Donnell, et al., 2015a; Welborn et al., 2016). However, dmPFC activity (along with the supplementary motor area (SMA) and dorsal anterior cingulate (dACC)) during conformity has also been attributed to conflict monitoring or threat detection (Berns et al., 2010; Klucharev et al., 2009, 2011; Tomlin et al., 2013). Follow up analyses examining whether activity in conflict monitoring regions (primarily including the anterior insula, dACC, and SMA) was associated with self-construal and gender found that independent men displayed marginally increased activity in conflict monitoring regions. Thus, independent men may value social norms more broadly and use social norms to consider the intentions of others and detect when they are misaligned with expressed norms. Although, VS activity (a region within the positive valuation system) has also been associated with salience (Berns et al., 2005; Lee et al., 2022) and increased connectivity within this network has been associated with conformity (Do et al., 2022). Thus, increased VS activity may be tracking salient social cues in the environment (Do et al., 2022; Lee et al., 2022). These possibilities may explain differences from previous research that found decreased activity in the VS was associated with conformity, where authors suggest VS activity signals prediction error in reinforcement learning (Klucharev et al., 2009).

Among women, having a stronger interdependent self-construal was unrelated to neural activity in our positive valuation and mentalizing regions of interest. However, exploratory whole brain analyses and subregion ROI analyses found that women displayed increased activity in sub-regions of the TPJ and superior temporal gyrus, regions associated with mentalizing (Saxe, 2010), when conforming to recommendations that differed from their own compared to maintaining their own opinion. These findings are consistent with previous literature that suggests both identity as a women and interdependent self-construal is associated with greater emphasis on communion (Abele & Wojciszke, 2007; Markus & Kitayama, 1991; Moskowitz et al., 1994; Singelis & Sharkey, 1995; Triandis, 2018).

Taken together, these findings are consistent with the idea that for people whose self-perceptions (i.e., self-construal) are more congruent with societal norms (i.e., gender norms), they show increased activity in mentalizing and positive valuation regions when conforming to others compared to not conforming. One possibility is that people who are more sensitive to societal expectations of gender roles also care more about what others think, and therefore are more likely to conform when they consider others' viewpoints, perhaps from an increased sense of belonging or group membership for doing so. Alternatively, social endorsements may make the popular opinion seem more valuable or important to follow (Baumeister & Leary, 2017; Cascio, Scholz, & Falk, 2015b; Cialdini & Goldstein, 2004; Ruff & Fehr, 2014), particularly for people whose self-perceptions align with societal norms.

4.3. Neural correlates of conformity and incongruency between self-construal and gender

We also examined whether differences in self-construal and gender as they relate to being incongruent with societal expectations of agency and communion were associated with neural mechanisms previously associated with conformity. Our results suggest that among men, having a stronger interdependent self-construal was associated with decreased activity in the mentalizing network during conformity compared to maintaining one's own opinion. Moreover, an exploratory whole brain analysis revealed that among men a stronger interdependent self-construal was associated with decreased activity in the dlPFC during conformity, a region previously associated with emotion regulation (Silvers et al., 2015; Staudinger et al., 2011), decision-making, and working memory (Krawczyk, 2002). Decreased dlPFC activity associated with decreased emotion regulation during conformity among interdependent men may be due to masculine discrepancy stress (i.e., stress associated with not conforming to gender roles), which has been associated with less effective emotion regulation strategies (Berke et al., 2018). Among women, having a stronger independent self-construal was significantly associated with decreased neural activity in the mentalizing network when they conformed to peer recommendations (compared to when they did not conform). Exploratory whole brain analysis also found decreased activity in the dmPFC, a region associated with mentalizing (Arioli et al., 2021; Koster-Hale & Saxe, 2013), during conformity that was associated with a stronger independent self-construal among women.

Previous research on conformity suggests that the dmPFC tracks cognitive imbalance between the opinions of the self, others, and attitudes towards others, such that when one's opinions differ from others increased dmPFC activity is associated with liking others, whereas decreased dmPFC activity is associated with disliking others (Izuma, 2013). In the current study, dmPFC was positively associated with conformity among independent men (i.e., more congruent with society perceptions) but negatively associated with conformity when society perceptions were incongruent (i.e., interdependent men, independent women). Thus, dmPFC activity may also be tracking cognitive imbalance based on attitudes towards others. However, future studies would need to directly measure attitudes towards others to confirm this possibility.

The current study adds nuance to prior research linking self-construal to conformity and gender to conformity. On one hand, past literature would predict that, in general, people higher in

interdependent self-construal (Markus & Kitayama, 1991), and groups who are expected to be more communal (such as women) might both conform more and show a stronger relationship between mentalizing and conformity (Abele & Wojciszke, 2007; Blackstone, 2003; Goldner, 1988; Stets & Burke, 2000). However, our results highlight that congruence between gender identity and self-construal matters in how people used their brains when conforming. We found that men with a stronger interdependent self-construal displayed less activity in mentalizing and emotion regulation regions (Silvers et al., 2015; Staudinger et al., 2011). Women with a stronger independent self-construal displayed less activity in regions associated with mentalizing. Findings associated with independent women may suggest that they are less likely to consider the mental states of others when conforming to peer opinions. These results may imply that for people whose self-perceptions are less congruent with societal perceptions, they show less activity in mentalizing regions when conforming to others compared to not conforming.

4.4. Conclusion

The current study examined whether differences in gender and interdependent and independent self-construal are related to neural processes that were previously associated with conforming to the preferences of others. Our findings suggest that self-construal is related to the underlying neural processes associated with conformity and this relationship is different depending on gender, such that increased mentalizing activity during conformity was associated with interdependent women and independent men, whereas decreased mentalizing activity during conformity was associated with independent women and interdependent men. These findings may suggest that for people whose self-perceptions (i.e., self-construal) are more congruent with societal norms (i.e., gender norms), they show more activity in mentalizing regions when conforming to others compared to not conforming; for people whose self-perceptions are less congruent with societal perceptions, they show less activity in mentalizing regions when conforming to others compared to not conforming. These results show that the mechanisms driving conformity differ across groups in theoretically meaningful ways.

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Ethics approval statement

This study was approved by the University of Pennsylvania Institutional Review Board (#819918 on June 18, 2014; #820733 on August 21, 2014).

Declaration of competing interest

The authors do not have any conflicts of interest.

Data availability

The data and analyses scripts in R have been made publicly available at OPENISPSR (https://www.openicpsr.org/openicpsr/project/184271/version/V1/view). Neuroimaging data related to the exploratory whole brain analyses are available by request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2023.112299.

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