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# Rating gender stereotype violations: The effects of personality and politics

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The Gender Stereotype Effect in language comprehension refers to the increased processing load that occurs when comprehenders encounter linguistic information that is incongruent with their understanding of gender stereotypes; for example, upon encountering the pronoun *he* in the sentence *The maid answered the phone because he heard it ring*. We investigate the Stereotype Effect using appropriateness and correctness ratings and ask whether it is modulated by individual differences in participants' personality and political ideology. Results from this study indicate that the Stereotype Effect can be replicated in an offline paradigm and that the Effect is specific to a discourse character's gender: sentences describing male agents fulfilling stereotypical female roles were rated lower in both appropriateness and correctness than sentences describing female agents fulfilling stereotypical male roles. Further, more open, conscientious, liberal, and empathetic individuals were more sensitive to the character gender-specific effect, rating stereotype incongruent sentences, particularly female role-male pronoun pairings, lower than congruent ones. Overall, these results point to certain individual differences being associated with differences in the strength of stereotype perception, indicating the possibility that these individuals use more top-down language processing, where comprehenders higher on these scales might be able to make more use of extra-linguistic, sociocultural factors in their language comprehension. Additionally, the results indicate a character gender-based difference in sociocultural stereotypes.

## KEYWORDS

psycholinguistics, social language comprehension, gender stereotypes, personality, political ideology, disgust sensitivity, empathy

## 1. Introduction

What happens when you read the following sentence? *The maid answered the phone because he heard it ring*. Were you surprised when you encountered the pronoun *he*, where you learned that the maid was a male? Research indicates that gender stereotypes, defined here as the perceived likelihood that a noun (e.g., *maid*) denotes male or female attributes (Irmen and Roßberg, 2004; Gygas et al., 2016), influence the language comprehension process. Indeed, research has shown repeatedly that processing phrases containing gendered role names takes more cognitive effort when the subject's gender contradicts expectations based on these stereotypes; for example, slowing down reading when the upcoming pronoun is incongruous with the stereotyped gender of the role name, as in the sentence above (Chang, 1980; Garnham et al., 2002; Kennison and Trofe, 2003). Further, this Stereotype Effect, the disruption of language comprehension upon encountering gender stereotype incongruousness, takes place immediately and automatically (Banaji and Hardin, 1996; Osterhout et al., 1997; Hanulíková and Carreiras, 2015; Redl et al., 2021), and may even override morpho-syntactic information (Molinaro et al., 2016). Notably, the Stereotype Effect does not occur when comprehenders encounter the following sentence, where the pronoun is congruent with the stereotyped gender of the role name: *The maid answered the phone because she heard it ring*.

This study takes the first steps to systematically explore the extent to which the comprehension of sentences with gender stereotyped role names is affected by participant-based

individual differences in personality traits and political ideology. We will show that participants' offline ratings of these sentences are modulated by openness, conscientiousness, ability to empathize and liberal political ideology. We will further show that these results are in line with recent psycholinguistic research from other types of sociocultural language comprehension, i.e., language constructed and interpreted using social and cultural world knowledge, as well as the predictions stemming from the sociological Social Role Theory's account of the origin and nature of gender stereotypes.

Gender stereotypes are widely reflected in the distributional structure of the world's languages (Lewis and Lupyan, 2020; Misersky and Redl, 2020) and have been shown to be stable with very little change in core gender roles over time (Haines et al., 2016). This is especially the case for male stereotypes that have been shown to be more stable than female gender roles. Stereotypical beliefs about occupations and social roles appear early in language acquisition and become more cemented in adulthood as individuals gain world knowledge (Gygax et al., 2019; Canessa-Pollard et al., 2022). Beliefs about stereotypical roles have been shown to be related to both social group behaviors and future expectations of role fulfillment (Sibley and Duckitt, 2008; Koenig and Eagly, 2014). Importantly, this concept is embedded in the sociological Social Role Theory, which posits that gender roles are behaviors constructed by and learned through socially common behaviors associated with men and women (Eagly and Wood, 1991; Eagly, 2013). This implies that individuals consciously perceive individuals who violate gender stereotypes (Diekmann et al., 2004): both men and women demonstrate increased attention paid toward people who perform outside of typical gender roles (Heilman et al., 2004). Hence, the Stereotype Effect seen during language comprehension is in line with this account. Importantly for the present study, the extent to which individuals engage in stereotyping depends on aspects of their identity (Sibley and Duckitt, 2008; Quadflieg and Macrae, 2011), such as their own experience with and conformity to gender roles and their overall personality profile. In line with this, recent research suggests that the Stereotype Effect in language comprehension might be modulated by individual, personality, and worldview based differences (see Canal et al., 2015; Grant et al., 2020, for gender identity).

Recent evidence suggests that sociocultural language comprehension containing socially constructed elements, such as voice-based inferences and irony (Van Berkum et al., 2009; Van den Brink et al., 2012; Hubert and Järvikivi, 2019; Puhacheuskaya and Järvikivi, 2022) is affected by individual differences in participants' personality traits and political beliefs.

Van den Brink et al. (2012) showed that words (e.g., *teddy bear*) in sentences clashing with a character's socially or culturally expected stereotypes (e.g., *I cannot sleep without my teddy bear in my arms*, spoken with a male adult voice) elicited an N400 effect similar to world knowledge violations (Hagoort et al., 2004). Participants in this study also completed (Baron-Cohen and Wheelwright, 2004)'s Empathy Quotient Questionnaire (EQQ). Importantly, the N400 for these stereotype violations, but not semantic anomalies, was affected by the listeners' ability to empathize: high empathizers showed a larger N400 effect than low empathizers, such that the N400 amplitude was predicted by the participants' EQQ score. A better ability to empathize predicted greater N400 effects and hence increased processing difficulties comprehending incongruent speaker identities. The authors presume that this increased ability to

understand and relate to speakers leads to increased processing loads when the speaker's identity contradicts stereotyped assumptions and speaker-based predictions. In other words, individuals with a strong ability to empathize are more attentive to socioculturally relevant information during language comprehension, resulting in heightened sensitivity to stereotype violations (see also, Hubert Lyall, 2019).

Subsequent research has shown that not only empathy, but also other personality traits similarly affect the processing of sentences clashing with speaker identity (*I sometimes buy my bras at Hudson's Bay*, spoken by a male speaker), including Big-5 (Goldberg et al., 2006) traits agreeableness and extraversion (Hubert Lyall and Järvikivi, 2021a) as well as the extent of the listeners' disgust sensitivity (Hubert and Järvikivi, 2019). Further, Hubert Lyall and Järvikivi (2021b) showed that the processing of these sentences was positively correlated with the participants' degree of conservatism (Wilson and Patterson, 1968).

Van Berkum et al. (2009) were the first to implicate political and moral views during language processing. They had two groups of participants read statements such as *Euthanasia is an acceptable vs. unacceptable course of action*. Whether participants were supporters of a Christian party or not, affected their EEG/ERP signatures (N250 and N400) for statements that were incongruent with their politically associated moral views (see Foucart et al., 2015, for L2 processing). Marrville (2017) showed that participants' political views significantly predicted their sentence completions [*Nathan (NP1) VERBed Kaleigh (NP2), because...*] with verbs depicting interpersonal events and relationships (e.g., *admire, envy, punish*), suggesting that people's political views modulated how they understood the causal relations in these events. For example, more conservative participants had more NP1 continuations for low dominant, high valence verbs often associated with female subjects (*thank*), but more NP2 continuations with low valence verbs often associated with male subjects (*criticize*). This pattern was reversed for more liberal participants. Niemi et al. (2020) replicated the effect and suggested that values like loyalty and obedience to authority correlated with judgments of the NP2 in the event as more likely to have allowed harmful outcomes of an action (see also, Puhacheuskaya et al., 2022).

Recently, Puhacheuskaya and Järvikivi (2022) examined the comprehension of ironic and literal comments embedded in dialogs spoken in a native vs. foreign accent. Listeners' political views (but not empathy) affected irony ratings: more conservative participants did more poorly in irony detection overall, independent of the speaker accent, and they tended to misinterpret literal compliments as sarcasm.

In sum, previous research, albeit sparse, suggests that personality and political ideology effects are confined to pragmatic, socially relevant language use, with notable absence of these effects for grammatical—morpho-syntactic and syntactic—violations (Hubert Lyall, 2019; Jiménez-Ortega et al., 2022). Given the prior research, we would expect gender stereotypes as par excellence social language to be sensitive to the individual differences outlined above. If certain personality traits, such as empathy or openness, lead to heightened sensitivity to and a stronger motivation to seek out and integrate new (socially relevant) information and to use this information to predict upcoming information during language comprehension (Van den Brink et al., 2012), we would expect them to affect the strength of the Stereotype Effect. At the same time, if the Social Role theory is correct, we would expect to see larger differences

between congruent and incongruent sentences for participants that score higher in these traits.

However, a unified investigation into the roles of these individual differences as they specifically pertain to gender stereotype comprehension has yet to be performed. Hence, this paper presents a unified exploration of the correlation of individual differences in personality traits, political ideology, and disgust sensitivity with participants' reactions to gender stereotyped sentences. We ask whether these individual difference can account for, at least in part, differences in the strength of the Stereotype Effect as measured by ratings of sentences that either align with gender stereotyped expectations or contain clashes with gender stereotyped expectations. We use a sentence rating paradigm in conjunction with a battery of four individual difference questionnaires chosen due to their strong internal validity (see Block, 1995) as well as their previous implication in language processing research: the Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness Personality Index - Revised (HEXACO PI-R; Ashton and Lee, 2007); the Political Ideology Questionnaire (PIQ; Grenier, 2006); and the Disgust Scale - Revised (DS-R; Haidt and Graham, 2007). We chose to use HEXACO PI-R, rather than the five factor model based BIG-5 inventory because of HEXACO's clear delineation of agreeableness, conscientiousness, and openness traits as pertaining to social, work and idea related engagement, respectively (Ashton and Lee, 2007).

## 2. Method

### 2.1. Participants

Ethics for this study were approved by the Research Ethics Office at the University of Alberta (PRO00089925). Ninety-four undergraduate students from introductory linguistics classes were recruited from the SONA participant pool at the University of Alberta, all of whom consented to participating in the study (72 female, 22 male; Age range = 17–54, Mean = 22.4). All were native speakers of Canadian English with normal or corrected-to-normal vision and received partial course credit for their participation.

### 2.2. Materials

Thirty-two experimental sentences were constructed, 16 with female and 16 with male stereotyped role names (i.e., occupations such as *nurse*, *doctor*, *secretary*, and *florist*). Role nouns for this study were adopted from Marrville (2017), all of which have been shown to strongly carry gender role expectations. Each sentence began with a role noun embedded in a noun phrase and a verb, followed by a short phrase, the causal continuation “because,” a pronoun segment, and finally an embedded verb phrase. The pronoun was either congruent or incongruent with the stereotypical gender of the role noun. To avoid unintentional ambiguity, each sentence contained only one agent; for example, *The dancer waved in the air because she/he was proud of the performance*. Filler sentences followed the same setup, but role nouns were used that did not have any gender stereotype associated with them, such as *student* or *peer*. There were no sentences containing semantic or syntactic errors. All materials are listed in the [Supplementary material](#) (1.1. Experimental Materials).

## 2.3. Procedure

Using Google Forms, each participant saw 32 experimental sentences fully counter-balanced in two lists, so that 16 of the sentences were Congruent and 16 were Incongruent. Items were counterbalanced such that each participant was exposed to an equal number of Female stereotypes and Male stereotypes, and thus an equal number of Female and Male pronouns. The same eight filler sentences were included in both lists. For each sentence, participants rated their Correctness and Appropriateness on two five-point Likert scales. No definition of Correctness or Appropriateness was given; we expected participants to view Correctness as a measure of the absence of linguistic errors and Appropriateness as a subjective measure of their own acceptance of the sentence. Hence, we expected no effect of Correctness ratings and an effect of Appropriateness ratings, where Correctness ratings would be stable across items and Appropriateness ratings would be lower for sentences containing gender stereotype clashes. After the completion of the experimental block, participants completed the post-questionnaires (HEXACO PI-R, DS-R, EQQ, and PIQ) in Google Forms. Finally, participants completed a language background questionnaire to ensure their status as native speakers of Canadian English.

## 3. Results

Generalized additive mixed-effects modeling (GAMMs) in R (Wood, 2017; R Core Team, 2020) allowed us to model the ratings scale data which is ordinal in nature (Baayen and Divjak, 2017). Since we were interested in the effects of individual differences, GAMMs allowed us to test the effects of these variables without assuming linearity. All plotting was done using the *itsadug* package (van Rij et al., 2017). All models included Rating as the dependent variable and random smooths for subject and item.

We first tested the effects of Rating Type (Correctness vs. Appropriateness), Congruence (Congruent vs. Incongruent gender stereotype-pronoun pairings), and Stereotype Gender (Feminine vs. Masculine) as categorical predictors, as well as participant Age and Gender as covariants. Age and Gender were non-significant ( $p = 0.670$ ,  $p = 0.694$ , respectively) and were dropped from further models. The final model ([Supplementary Table S1](#)) showed no effect of Rating Type ( $p = 0.089$ ) and no interaction between Rating Type and Congruence; however, across all responses ratings of Correctness were consistently higher than ratings of Appropriateness. Because there was no significant difference between ratings of Correctness and Appropriateness across items ( $p = 0.089$ ), we can conclude that the two dimensions do indicate the presence of the Stereotype Effect and likely approximate “Acceptability” ratings (see Schoenmakers, 2022). That is, participants likely took the terms Correctness and Appropriateness to refer to some elements of grammaticality and meaning, respectively, with some individual variation that was not significant across the two rating dimensions.

Instead, we found a significant effect of Congruence ( $p < 0.0001$ ) such that incongruent items were rated generally significantly lower in Correctness and Appropriateness than Congruent items. This reflects the finding that sentences involving contradictions to sociocultural world knowledge are more noteworthy during language processing. Importantly, low ratings should not be interpreted as indicating that the sentences are not plausible or that participants

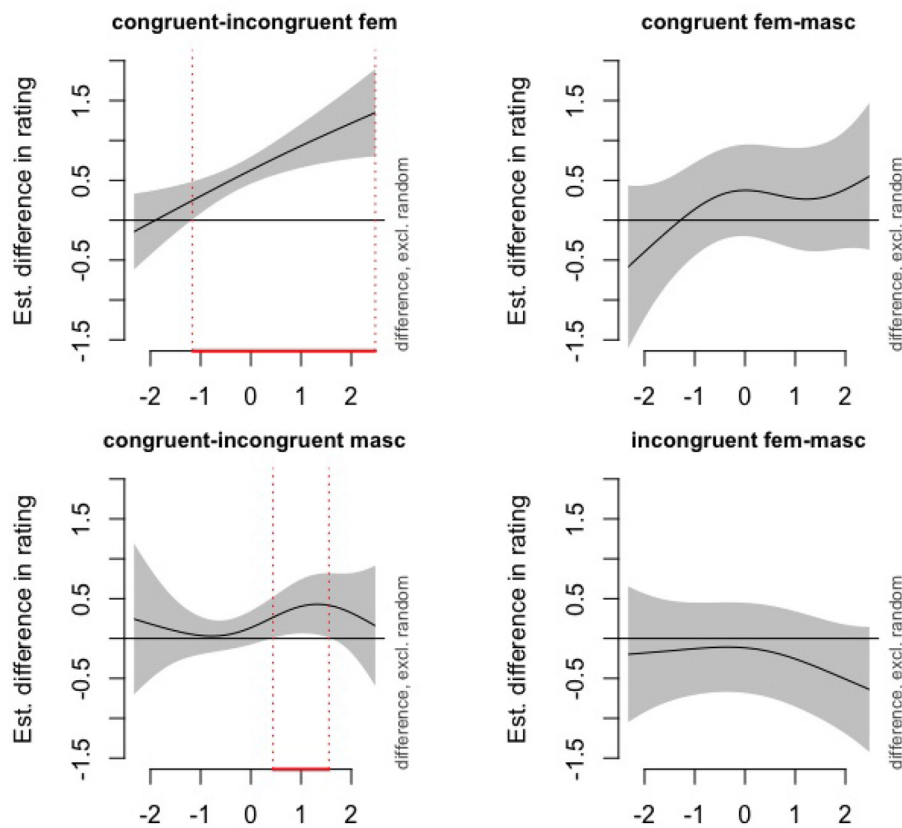


FIGURE 1

Openness: Difference plots depicting the interaction between openness and stereotype congruence. More negative/positive values on the x-axis indicate lower/higher openness. (**Upper left**) Congruent minus incongruent female stereotyped role name; (**Upper right**) congruent female minus congruent male stereotyped role name; (**Lower left**) congruent minus incongruent male stereotyped role name; (**Lower right**) congruent female minus incongruent female stereotyped role name. Vertical, red, dotted lines indicate the area of significant difference.

thought the situations described were not suitable in the real world. Rather, the low(er) ratings are most consistently interpreted as indicating that participants were attentive to some element of contradictory language, i.e., that of gender stereotype clashes, in line with previous results from language processing literature. Further, we observed an interaction between Congruence and Stereotype Gender ( $p < 0.001$ ). The interaction indicates that stereotypically female role names were consistently rated lower in Correctness and Appropriateness when they clashed with the pronoun in the sentence compared to stereotypically male role names—in other words, when female role names were followed by a masculine pronoun (see [Supplementary Figure S1](#)). Hence, even though the results replicate the stereotype incongruence effect repeatedly shown in the prior literature, it was qualified by an interaction suggesting that its strength was affected by the associated gender of the role name.

In order to inspect the effects of the individual difference measures on the ratings, we first formed a new 4-level predictor “Condition” by merging Congruence and Stereotype Gender. We also collapsed Rating Type into one category Rating. We centered all individual difference predictors and then tested each individual difference predictor separately. In order to avoid p-hacking and inflation of the chance of false positives, we fitted only one model for each individual difference predictor separately, with Rating as the dependent variable and Condition as a parametric fixed predictor. In addition, each model included a smooth term for the interaction between Condition and the given individual difference predictor

(HEXACO PI-R trait, EQQ, Political Ideology), as well as random smooths for participant and item. As we found no significant effect of Disgust, in what follows, we will report the results from HEXACO PI-R Traits, Empathy (EQQ), and Political Ideology.

### 3.1. Personality

We found no effects of Honesty-Humility, Emotion, Extraversion, or Agreeableness. However, we did find that both Openness and Conscientiousness significantly predicted the ratings. The corresponding statistical models are summarized in [Supplementary Tables S1, S2](#). The first rows provide parametric coefficients for Condition (reference level = congruent female). As to the smooth terms, the edf (effective degrees of freedom) indicates the degree of the “wiggleness” of each regression line, where values greater than 1 indicate non-linearity. The  $p$ -values indicate whether the lines are significantly different from 0 for any value on the x-axis (openness or conscientiousness, respectively). Therefore, in order to both interpret the shape of the regression lines and, importantly, to determine whether the lines differ from each other significantly, visual inspection of plots is necessary.

Based on statistical modeling, [Figures 1, 2](#) illustrate the differences in Rating between the 4 conditions for Openness and Conscientiousness, respectively (i.e., the differences between



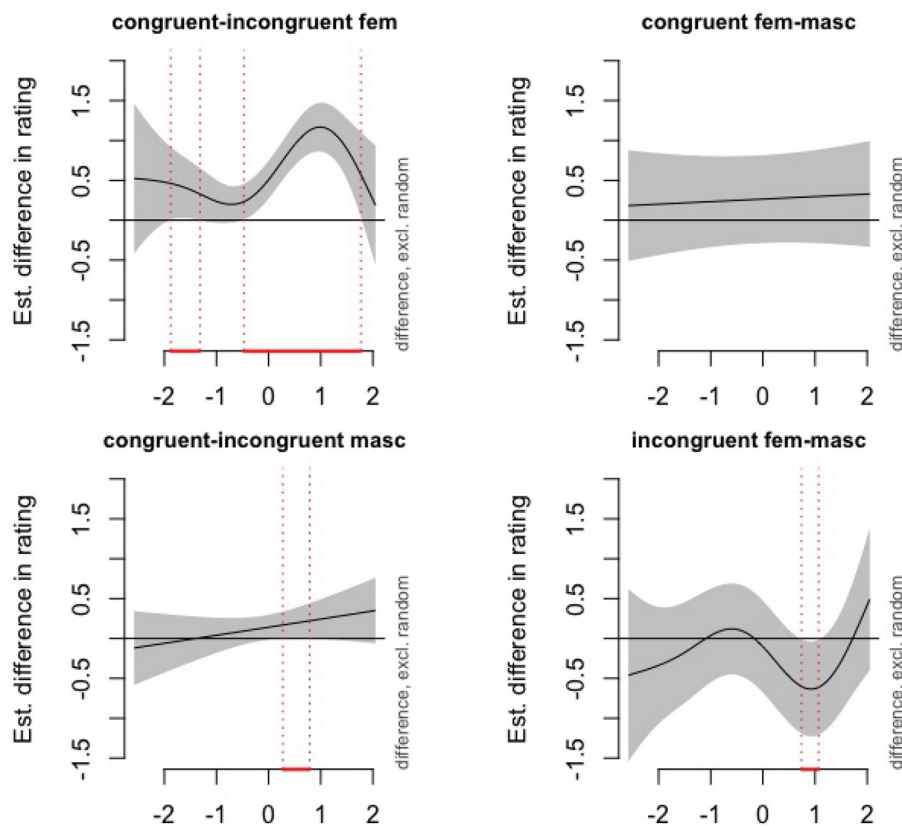


FIGURE 2

Conscientiousness: Difference plots depicting the interaction between conscientiousness and stereotype congruence. More negative/positive values on the x-axis indicate lower/higher conscientiousness. (Upper left) Congruent minus incongruent female stereotyped role name; (Upper right) congruent female minus congruent male stereotyped role name; (Lower left) congruent minus incongruent male stereotyped role name; (Lower right) congruent female minus incongruent female stereotyped role name. Vertical, red, dotted lines indicate the area of significant difference.

the respective regression lines). For all Figures, gray shading marks 99% confidence intervals, and the red dotted vertical lines indicate the points on x-axis between which the respective conditions (regression lines) are significantly different from one another.

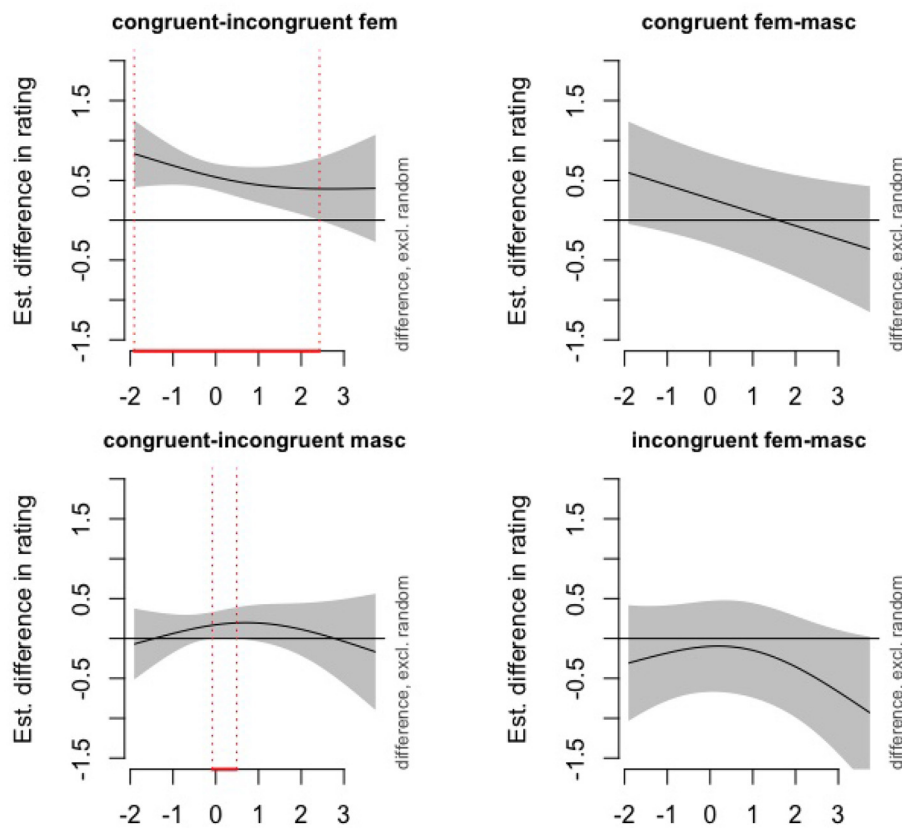
As Figure 1 (upper left panel) shows, more open participants rated stereotype congruent items as relatively higher than stereotype incongruent items when female stereotyped role names were followed by a masculine pronoun. This difference grows almost linearly starting with mid-low open participants. Further, as Supplementary Figure S2 shows, more open participants tended to give higher ratings overall, in addition to the observed difference between congruent and incongruent female stereotypes. In addition, there is a small difference between masculine congruent and incongruent stereotypes as well that is significant in mid-to-high openness range. High scores in the Openness to Experience category (Lee and Ashton, 2004; Ashton and Lee, 2007) indicate that an individual is inquisitive about life, imaginative, eager to embrace new experiences, and interested in learning about all domains of people, places, and things. Conversely, low scores in this category reflect little intellectual curiosity, lack of interest in creative pursuits, and avoidance of people, places, things, and ideas that seem radical or unconventional.

Figure 2 plots the effects for Conscientiousness. High scores in the Conscientiousness category of the HEXACO PI-R scale are

observed for people who deliberate carefully when making decisions and pay more attention to their surroundings, both physical and mental. Conversely, people with lower scores in the Conscientious category are unconcerned with their surroundings, avoid difficult tasks, make decisions with little reflection and introspection, and are more accepting of situations that contradict their experience. As the Figure 2 shows, the effect was mostly confined to more highly Conscientious participants, who showed a greater difference between Congruent and Incongruent Female Stereotyped sentences. Importantly, there was also a less pronounced effect for Masculine Stereotypes that suggests that more highly Conscientious participants rated Incongruent Masculine Stereotype sentences lower than Incongruent Feminine Stereotyped ones. This is confirmed by Supplementary Figure S3.

### 3.2. Political ideology

People who score higher on the PIQ are more conservative in their political, economic, social, and personal beliefs. This means that these individuals are usually opposed to concepts like abortion and gay marriage and prefer political ideologies that support personal responsibility and reliability. Contrastively, people who score lower on the scale are less conservative (i.e., more liberal): they prefer equal



**FIGURE 3** Political Ideology: Difference plots depicting the interaction between political ideology and stereotype congruence. More negative/positive values on the x-axis indicate lower/higher conservatism. **(Upper left)** Congruent minus incongruent female stereotyped role name; **(Upper right)** congruent female minus congruent male stereotyped role name; **(Lower left)** congruent minus incongruent male stereotyped role name; **(Lower right)** congruent female minus incongruent female stereotyped role name. Vertical, red, dotted lines indicate the area of significant difference.

access to resources, support concepts like abortion and gay marriage, and believe in a more collective mindset.

The model for Political Ideology is shown in [Supplementary Table S3](#). As [Figure 3](#) shows, it was the less Conservative (i.e., more Liberal) participants who rated Incongruent Female Stereotyped sentences relatively increasingly lower than Congruent ones. As the Figure shows, the effect was mostly confined to the more liberal end of the spectrum with the more conservative and showing less or no effect (but, see below). As [Supplementary Figure S4](#) suggests, this effect was at least partly due to downward curving of the incongruent female line, whereas the congruent line kept rising linearly. There was a difference between Masculine Congruent and Incongruent sentences as well, but this difference was significant only around the mid-range of Conservativeness.

### 3.3. Empathy

High scores on the Empathy Quotient Questionnaire reflect an individual’s ability to experience emotions, particularly during social interactions. These people are able to imagine the emotional experiences of other, meaning that they can understand, feel, and respond to social stimuli, hence correlating with strong

socialization skills and interest in the world. In contrast, individuals low in empathy are weaker at socialization and typically less interested in the feelings and mental states of others ([Baron-Cohen and Wheelwright, 2004](#)).

The model for Empathy is shown in [Supplementary Table S4](#). As [Figure 4](#) shows, the results reflect those from Openness and Political Ideology in that the higher the participants scored in empathy the more different they tended to rate Incongruent sentences compared to Congruent ones. As the Figure shows, this trend was clearest within the mid-range, possibly due to there being less data at both ends of the scale. Indeed, [Supplementary Figure S5](#) suggests that within the mid-empathy range, whereas the ratings for congruent sentences continued to rise, there was little or no change in the ratings for congruent sentences. There was also a similar but shorter lived effect for male stereotypes that was confined in the upper mid-empathy range.

### 4. Discussion

The results of this rating study indicate that the Stereotype Effect is present even during offline language processing. Firstly, in line with previous research (e.g., [Chang, 1980](#); [Garnham et al., 2002](#); [Kennison and Trofe, 2003](#)), we found overall lower ratings of stereotypically incongruent sentences compared to congruent

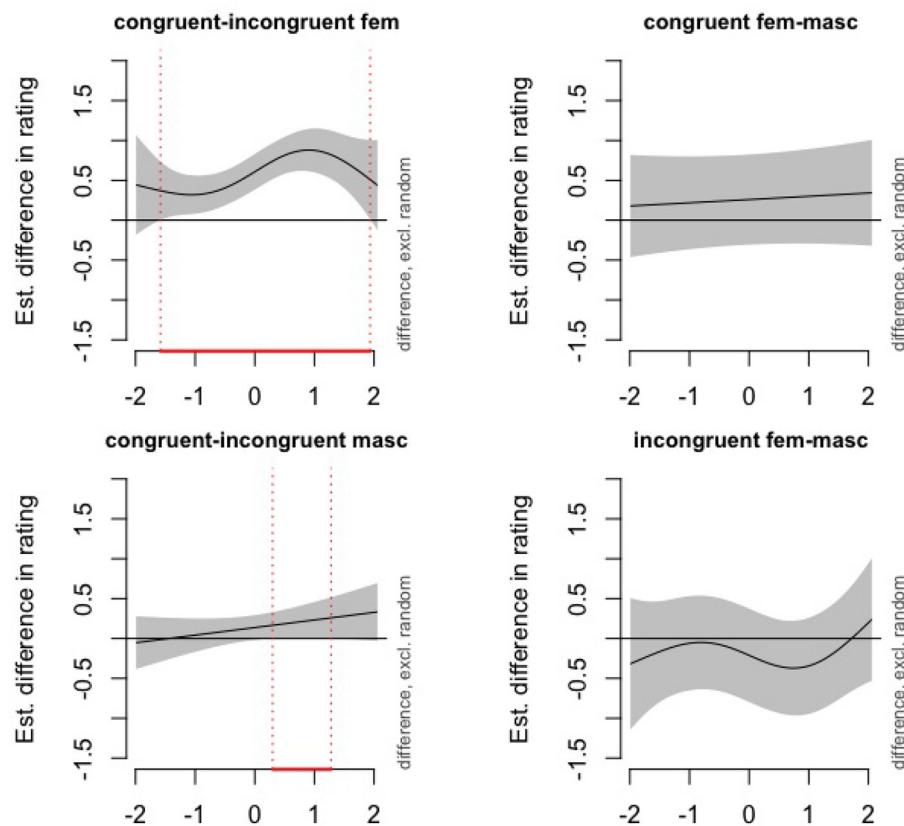


FIGURE 4

Empathy: Difference plots depicting the interaction between empathy and stereotype congruence. More negative/positive values on the x-axis indicate lower/higher empathy. (**Upper left**) Congruent minus incongruent female stereotyped role name; (**Upper right**) congruent female minus congruent male stereotyped role name; (**Lower left**) congruent minus incongruent male stereotyped role name; (**Lower right**) congruent female minus incongruent female stereotyped role name. Vertical, red, dotted lines indicate the area of significant difference.

ones, reflecting the finding that sentences involving contradictions to sociocultural world knowledge are more noteworthy during language processing. Importantly, low ratings should not be interpreted as indicating that the sentences are not plausible or that participants thought the situations described were not suitable in the real world. Rather, the low(er) ratings are most consistently interpreted as indicating that participants were attentive to some element of contradictory language, i.e., that of gender stereotype clashes, in line with previous results from language processing literature (Garnham et al., 2002; Kennison and Trofe, 2003).

Moreover, we found that the degree of the Stereotype Effect experienced by participants depended on the typical gender of the stereotype itself: female stereotype violations correlated with lower ratings than male stereotype violations. That is, a man (identified by the pronoun *he*) fulfilling a stereotypically feminine role (such as *florist*) elicited lower ratings than a woman (identified by the pronoun *she*) fulfilling a stereotypically masculine role (such as *butcher*). This result suggests that male individuals are more strongly believed to perform as per sociocultural expectations of gender roles compared to women (see Gygas et al., 2016). This gender-specific Stereotype Effect (i.e., specific to the stereotyped gender of the role noun) has two potential explanations, both of which are not necessarily mutually exclusive. Firstly, previous research has found that typical male roles, reflected through stereotypes, are overall more stable over time, which suggests that movement by women to masculine roles is more

likely over time than the other way around (Haines et al., 2016). In line with this, a female pronoun following a stereotypically masculine role name is considered more acceptable than a male pronoun following a stereotypically female role name. Additionally, research has shown that both male subjects and stereotypically masculine role names are preferred as subjects and easier to integrate during language comprehension compared to their female counterparts (Esaulova and Stockhausen, 2015; Realı et al., 2015; Marrville, 2017; Redl et al., 2021), which may have partly masked the stereotype effect for male subjects.

Importantly, the results of this study indicated that individual differences in personality traits and political ideology, but *not* disgust sensitivity, significantly modulate the perception of sentences containing gender stereotype clashes. In other words, the results suggest that a reader's personality and political profile influences how noteworthy contradictions to sociocultural world knowledge are during language comprehension. Firstly, our research suggests that people who are more open to experience, empathetic, conscientious, and politically liberal are generally more sensitive to information about gender stereotypes than their less open, less empathetic, less conscientious, and more conservative counterparts. First, this result is in line with previous research suggesting that, in general, higher empathizing listeners are more sensitive to violations of speaker identity based stereotypical expectations than lower empathizing listeners (Van den Brink et al., 2012). Second, our results are also

in line with research showing that politically more liberal leaning participants are perhaps better at detection of irony and interpret interpersonal verbs differently than more conservative leaning participants (Marrville, 2017; Niemi et al., 2020; Puhacheuskaya and Järvikivi, 2022).

Notably, participants who were more empathetic, open to experience, and politically more liberal showed an increased sensitivity to sentences directly containing female gender stereotype clashes. To reiterate, higher scores on the EQQ indicate that these individuals have strong socialization skills and interest in the world (Baron-Cohen and Wheelwright, 2004); higher scores on the openness to experience dimension of the HEXACO PI-R indicate that these individuals are inquisitive about life, imaginative, eager to embrace new experiences, and interested in learning about all domains of people, places, and things (Ashton and Lee, 2007); low scores on the PIQ indicate liberalism such that these individuals prefer equal access to resources, support concepts like abortion and gay marriage, and believe in a more collective mindset (Grenier, 2006). These three dimensions have been shown to be correlated (e.g., Riemann et al., 1993; Sparkman et al., 2019), indicating attentiveness to and investment in the social surroundings, and, as we showed, also follow similar patterns of integration of sociocultural knowledge during language comprehension. The fact that these participants were increasingly more sensitive to incongruity with feminine stereotyped role names further underlines the nature of this gender-specific Stereotype Effect discussed above by emphasizing the historical stability of masculine gender roles and the potential language processing facilitation of male pronouns and role names.

In turn, highly conscientious participants were sensitive both to male and female stereotype violations. It is interesting that the Stereotype Effect did not appear to be specific to the stereotyped gender of the role names here to the same degree. However, previous research might help to explain this: high scores on the conscientiousness dimension of the HEXACO PI-R indicate that these individuals deliberate carefully when making decisions and pay more attention to their surroundings, both physical and mental (Ashton and Lee, 2007), suggesting that these individuals are analytical and sensitive to errors, perhaps explaining why there was less of a gender-specific Stereotype Effect here.

Disgust sensitivity, though correlated with high degrees of Conservatism (Inbar et al., 2009, 2012), showed no modulation of the Stereotype Effect. This lack of effect suggests that the Behavioral Immune System (Molho et al., 2017; Karg et al., 2019) may not be implicated in the absence of speaker-based cues (cf. Hubert Lyall and Järvikivi, 2021a) or linguistic tasks that do not directly invoke in and out grouping (cf. Reid et al., 2012; Calkins, 2022).

Finally, to address the elephant-in-the-room: would it not be intuitively more expected that more conservative, not more liberal, participants would rate female stereotype violations lower than congruent sentences? Perhaps this would have been the case, had we asked them to explicitly consider (violations of) stereotypically female vs. male roles. First, that we did not observe this result underlines that participants were engaged in evaluating the meaning of the sentences, i.e., in language comprehension, not in explicit judgement of whether women should or should not do men's jobs. Second, and important, our results show that, as predicted by the social role theory, both more conservative and more liberal (or less/more open, conscientious and empathetic) participants are subject to largely the same world knowledge, including the same

conceptions of (stereo)typical female and male roles in the society. The latter are just more sensitive to this and other socially relevant information (see, e.g., Tetlock, 1983; Amodio et al., 2007; Jost and Amodio, 2012), and they are also better at using this information for the purposes of language comprehension. This is also in line with the view of political ideology as motivated social cognition, where liberal political ideology (and correlated personality traits) is associated with a stronger motivation to seek out new information and integrate potentially conflicting sources of information to arrive at a more fine grained understanding of the society and reality (Jost et al., 2003; Jost and Amodio, 2012).

There are some limitations that should be discussed. First, because we recruited undergraduate participants from our campus, the current results are based on a convenience sample. As a result, most of our participants were young women, which raises the question whether participant gender, not the measures used here, would explain the differences (cf. e.g., Szuba et al., 2022). Indeed, as Supplementary Figure S7 shows, our sample was skewed to the liberal end of the political ideology scale. However, if we look at the distribution of HEXACO traits and EQQ (Supplementary Figures S6, S7), we see that they were fairly uniformly distributed. Moreover, Van den Brink et al. (2012) showed that empathy, not gender, predicted the size of the N400 in their study. Further, previous studies showing personality effects in language processing have used balanced samples, but not shown any participant gender effects (Hubert Lyall, 2019; Hubert Lyall and Järvikivi, 2021a). Regardless, future examinations of conservatism and its modulation of the Stereotype Effect should involve a more balanced sample, recruited from beyond the boundaries of a university campus. Finally, though the gender roles used in the materials of this study have been shown to strongly carry gender role expectations (Marrville, 2017), models did not include stereotype strength as a variable. Future investigations should incorporate ratings of stereotype strength in their analyses.

## 5. Conclusion

This study highlights several implications for studies of language processing. Firstly, in line with previous research, sociocultural knowledge played an important role in the comprehension of our social pragmatic sentences, in that statements containing violations of common gender stereotypes were perceived more strongly than statements that are aligned with these gender stereotypes. Importantly, this effect was more pronounced for female gender stereotypes, indicating that statements that contradict world knowledge about female gender roles have a strong effect in language processing; in other words, men are perhaps more expected to fill male gender roles. Secondly, the role of this sociocultural knowledge in the comprehension of social pragmatic sentences can be predicted to an extent based on an individual's personality profile, including their personality traits, political ideology, and ability to empathize. Indeed, individuals who are more open to experience, conscientious, liberal in their political ideology, and empathetic experience increased attention when confronted with gender stereotype violations. This indicates that people possessing these personal traits may have stronger socio-cultural world knowledge and might allocate more resources to this information during language comprehension. Notably, high scores in openness to experience, liberalism, and empathy



predicted significantly lower ratings of appropriateness to female stereotype clashes, while high scores in conscientiousness predicted significantly lower ratings of appropriateness to both female and male stereotype violations.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

Ethics for this study were approved by the Research Ethics Office at the University of Alberta (PRO00089925). The patients/participants provided their written informed consent to participate in this study.

## Author contributions

SH-T and JJ jointly conceived and designed the experiments, analyzed the data, contributed materials and analysis tools, and wrote the manuscript. SH-T performed the experiments. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fcomm.2023.1050662/full#supplementary-material>

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