Associations between openness and intergroup attitudes: A facet level analysis☆

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ABSTRACT

Openness is consistently linked with intergroup attitudes. However, research gaps (e.g., overreliance on the NEO facet structure and samples from the USA) suggest that current evidence might not generalize across different structures of openness and cultures. This paper addresses key gaps in existing research by examining how three structures of openness (NEO, SFOS, and HEXACO) predict intergroup attitudes (prejudice and social tolerance) within two distinct cultural contexts (Singapore and the United States). Through two online surveys ($n = 318$ for Study 1 and $n = 526$ for Study 2), multiple regression analyses reveal a consistent pattern: (a) the NEO openness factor more strongly predicts both prejudice and social tolerance compared to HEXACO and SFOS in these cultural contexts; (b) the facet of tolerance shows a marked association with higher social tolerance and reduced affect-based prejudice, exceeding the predictive strength of other facets; and (c) the facet of liberalism predicts cognitive-based prejudice more significantly than the other facets of openness. Our findings informed the current theoretical understanding of intergroup attitudes and improved future predictive modelling of prejudice and social tolerance. Limitations of the research design and implications of the results are discussed.

Intergroup attitudes, particularly prejudice and social tolerance, are crucial in determining whether a society thrives in inclusivity or succumbs to divisive forces. Since the 1950s, psychologists have attempted to locate the roots of prejudice (i.e., negative evaluation of minorities; Allport, 1954) and social tolerance[1] (i.e., positive attitudes towards diversity; Martin & Westie, 1959), where openness (i.e., the disposition towards cognitive exploration; Woo et al., 2014) has consistently emerged as a strong predictor of these attitudes (Duckitt & Sibley, 2010). The dual process model (DPM) suggests that individuals with lower levels of openness tend to prioritize the stability of their community, making them less likely to value diversity and more inclined to view minorities as potential threats (Duckitt & Sibley, 2010). Notably, a recent meta-analysis (Blais-Rochette et al., 2022) of 24 studies involving 11,944 participants found that openness negatively predicted prejudice ($\rho = -0.29$), while across 17 studies with 30,167 participants, openness positively predicted social tolerance ($\rho = 0.34$). However, despite the evidence confirming the prominent associations between openness and both prejudice and social tolerance, the nuances of how openness relates to intergroup attitudes remain largely unexplored. For instance, the existing evidence has excessively relied on the NEO interpretation of openness (Table 1; Ng et al., 2021). This common issue, recognized by many personality psychologists (e.g., Connelly et al., 2014), implies that the current assertion that "openness strongly predicts intergroup attitudes" might be more accurately interpreted as "the NEO openness factor strongly predicts intergroup attitudes", overlooking other significant personality models like the HEXACO (Honesty-humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness; Lee & Ashton, 2004) and the Six Facet Openness Structure (SFOS; Woo et al., 2014).

We use the term *openness factor* to refer to the structure used to measure the broad openness domain and the term *openness facet* to refer to the specific underlying traits within a given structure of openness (Table 1). Not all openness factors are the same (Ziegler & Bäckström, 2016). Specifically, observed associations between openness factor and outcomes often depend on trait operationalizations (i.e., the number and type of facets used in measuring the openness factor; Ziegler &

Bäckström, 2016). For instance, the NEO openness factor exhibited a stronger (negative) correlation with prejudice than the Big Five Inventory (BFI) openness factor (Sibley & Duckitt, 2008). Similarly, the NEO openness factor showed a stronger (positive) correlation with social tolerance than the BFI (Han & Pistole, 2017). The NEO openness factor may have captured the structure and facets of openness that are more predictive of intergroup attitudes than the openness factor in the BFI (Sibley & Duckitt, 2008). Notably, the BFI openness scale lacks items addressing the facets of liberalism and adventurousness (John et al., 2008), which could explain its weaker associations with intergroup attitudes.

However, the heavy emphasis on the NEO openness factor means that the current literature cannot determine which structure of openness best predicts prejudice and social tolerance (Ng et al., 2021). Furthermore, regression models that focus solely on facets account for a larger proportion of variance in prejudice (Ekehammar & Akrami, 2007) and social tolerance (Anglim et al., 2019) than models using only factors, suggesting that capturing facet-specific variance is crucial for accurately predicting intergroup attitudes. Identifying the criterion-related relationships of openness facets also uncovers associations with outcome

Table 1
A unified taxonomy of facets of openness.

Aspect	Themes	Definition	Facet Structures and Facets		
			NEO	SFOS	HEXACO
Complex Thinking	Intellectual Interests	Desire to gain insights into the world			*Inquisitiveness* • I enjoy looking at maps of different places. *Unconventionality* • I like hearing opinions that are very different from those of other people.
	Self-assessed Intelligence	Perceived ability to think quickly, solve problems, and process information		*Intellectual efficiency* • I grasp scientific theories easily	
	Intellectual Curiosity	Enjoyment of learning new things, thinking about complexity, and reflecting on thoughts	*Intellect* • Love to read challenging material	*Curiosity* • I love to do experiment and see the results	
	Imaginative	Ability to have original thoughts and a desire to create		*Ingenuity* • I can develop inventive ideas of high quality	*Creativity* • I would like a job of drawing a comic strip or an editorial cartoon
Variety Seeking	Non-Traditionalism	Receptiveness to new ideas, cultures, and perspectives	*Liberalism* • Believe that there is no absolute right or wrong		
	Novelty-seeking	Willingness to explore new environments and try new ways of doing things	*Adventurousness* • Prefer variety to routine		
	Diversity	Embraces a variety of attitudes, beliefs, and lifestyles		*Tolerance* • I like to hear different people's views on political issues	
	Aesthetic Appreciation	Engagement in the arts and perceptual experiences	*Artistic Interests* • See beauty in things that others might not notice	*Aesthetics* • I see the beauty in art when others do not *Depth* I am fascinated by meditation and processes which encourage me to look inward	*Aesthetic Appreciation* • I can spend a long time studying a painting that I like
	Openness to emotions	Sensitivity to aesthetic emotions, complex feelings, and strong moods	*Emotionality* • Experience my emotions intensely		
	Fantasy	Tendency to daydream and mind wander	*Imagination* • Have a vivid imagination		

Note. Adapted from Christensen et al. (2019), Connelly et al. (2014), and Woo et al. (2014).

variables that may be obscured when facet scores are aggregated into factor scores. We propose that utilizing a comprehensive taxonomy of openness facets, which considers multiple structures of openness and their connections to intergroup attitudes, will offer researchers insights into the specific trait mechanisms through which openness shapes these attitudes. To our knowledge, no study has analyzed the relationship between intergroup attitudes and the structures and facets of openness in the same work. Our paper aims to explain openness's role in intergroup attitudes by examining which overall facet structure and specific facets of openness are most strongly associated with prejudice and social tolerance.

1. Conceptualizations of openness

Personality psychologists have proposed various structures and facets for the openness trait, utilizing two main approaches for identification: the questionnaire approach, which applies factor analysis to measures of openness, and the lexical approach, which reduces descriptive adjectives (or lexicons) of openness to derive the structure and facets of openness (Woo et al., 2014). Based on the questionnaire approach, the NEO openness factor (Costa Jr. & McCrae, 1992) follows a six-facet structure, emphasizing "variety-seeking" tendencies (Table 1; Connelly et al., 2014). In the NEO model, the openness factor is conceptualized as the tendency to engage with novel situations to see and experience the world in unusual ways (Costa Jr. & McCrae, 1992), with the facet of artistic interests representing the core of the NEO openness factor (John et al., 2008). It is important to note that although the NEO model was influenced by earlier lexical work (Costa Jr. & McCrae, 1992), its conceptualization of openness encompasses a broader range of traits and excludes the intellectual ability facet that is part of the lexical-based openness factor.[2]

Conversely, the HEXACO model (Ashton & Lee, 2007) emerged from recent lexical studies where a six-factor structure demonstrated greater replicability among non-Germanic and Slavic language families. In the HEXACO model, the openness factor is conceptualized as an individual's engagement with idea-related pursuits. This model adopts a narrower interpretation of openness, excluding facets related to religious and ideological beliefs, and operationalizes the openness factor using a four-facet structure (Table 1; Lee & Ashton, 2004). The HEXACO openness factor emphasizes "complex thinking" (Connelly et al., 2014), with the facet of unconventionality serving as its core (Ashton & Lee, 2007). To integrate existing models into a unified measurement model of openness, Woo et al.'s (2014) Six Facet Openness Scale (SFOS) introduces a new combination of facets, blending "complex thinking" (i.e., intellectual efficiency, ingenuity, curiosity, and depth) and "variety-seeking" (i.e., aesthetics and tolerance), in its operationalization of the openness factor. In the SFOS model, the openness factor is conceptualized as the tendency to approach novel stimuli as symbolic representations and enriching experiences (Woo et al., 2014). Despite structural differences, the openness factors captured by NEO, SFOS, and HEXACO models show high correlations ($r > 0.80$; Christensen et al., 2019), indicating significant overlap between these models. In this study, we emphasized these three models of openness as previous studies (i.e., Christensen et al., 2019; Connelly et al., 2014) have recognized the NEO openness factor, the HEXACO openness factor, and the SFOS openness factor as representative structures that, together, capture the breadth of the openness trait.

Efforts to unify the varied models of openness into a cohesive taxonomy, though still limited (e.g., Christensen et al., 2019; Connelly et al., 2014; Woo et al., 2014), are essential for advancing theoretical

clarity. Such integration not only refines our understanding of openness as a complex trait but also reveals its broader implications for important outcomes, offering a more comprehensive framework for future research. Different approaches in establishing such a taxonomy of openness facets include sorting the facets based on their definition into categories (Connelly et al., 2014), factor analysis of various scales of facets of openness (Woo et al., 2014), or using a network approach where a community detection algorithm was used on varied inventories of facets of openness to examine the conceptual coverage across different inventories (Christensen et al., 2019). Table 1 presents a synthesis of their taxonomic work and highlights a wide divergence in the facets identified within each structure of openness.

1.1. Hypothesized relations with intergroup attitudes

Many researchers have suggested that prejudice and social tolerance are separate forms of intergroup attitudes. Prejudice, a negative evaluation of minority groups and their members, is often associated with the activation of emotional centres of the brain (e.g., amygdala and insula; Chekroud et al., 2014) and mediated by right-wing authoritarianism (i.e., discomfort with uncertainty and a dislike for the disruption of established social norms; Sibley & Duckitt, 2008). Conversely, social tolerance, the positive attitudes towards diversity, are often associated with the activation of goal-directed and behavioral regulation centres of the brain (e.g., prefrontal cortex and anterior cingulate cortex; Beer et al., 2008; Amodio, 2014) and linked with intellectual capabilities, such as the ability to take on multiple perspectives (Brenick et al., 2019) and understand equalitarian principles (Sparkman et al., 2019). Consistent with this differentiation, openness predicts prejudice and social tolerance (Blais-Rochette et al., 2022) but through distinct pathways. That is, right-wing authoritarianism mediates the effect of openness on prejudice but not its effect on social tolerance, suggesting that different aspects of openness may be more relevant in predicting these intergroup attitudes.

As highlighted earlier, while many studies (Blais-Rochette et al., 2022; Sibley & Duckitt, 2008) have explored the link between the NEO Openness factor and intergroup attitudes, few have examined other models of openness. As a result, the relationship between different openness facets and intergroup attitudes remains unclear. In this paper, we hypothesized that the NEO Openness factor, which emphasizes variety-seeking (Table 1), would be a stronger negative predictor of prejudice than the SFOS and HEXACO Openness factors, given that prejudice has been associated with a tendency towards conformity (Gollwitzer et al., 2017) and resistance to diverse emotions (Makwana et al., 2021). The expectation aligns with the theoretical notion (i.e., DPM) that conformity and reluctance to engage with diverse experiences are key drivers of prejudice (Duckitt & Sibley, 2010). Additionally, we anticipated that the SFOS Openness factor, which places a heavier emphasis on complex thinking (Table 1), would be a strong positive predictor of social tolerance, given that the extant literature suggests that social tolerance is a direct result of abstract thinking capability (i.e., understanding equalitarian principles; Sparkman et al., 2019) and perspective-taking (Brenick et al., 2019).

Hypothesis 1. The NEO Openness factor predicts prejudice better than SFOS and HEXACO.

Hypothesis 2. The SFOS Openness factor predicts social tolerance better than NEO and HEXACO.

We hypothesized that the NEO facet of liberalism would be the strongest negative predictor of prejudice, aligning with substantial evidence that individuals with liberal political ideologies tend to resist authoritarianism (Sinn & Hayes, 2016), which often underlie prejudicial attitudes (Lin & Alvarez, 2020). For instance, research has shown that liberal individuals are more likely to support anti-discrimination laws (Jost et al., 2009), which correlates with lower levels of racial and ethnic

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[2] It is noted that the factor of openness identified in the Five Factor Model (FFM) and the Factor V identified in the Big Five model refer to separate research traditions. However, recent research has largely assimilated the FFM Openness with the Big Five Factor V; particularly, Lee and Ashton's (2004) HEXACO has adopted the FFM label of openness for their Factor V.

bias (Duckitt & Sibley, 2010). However, it is important to note that holding liberal ideologies does not necessarily equate to an unqualified acceptance of all forms of diversity (Brandt et al., 2014). This complexity is evident in cases of left-wing authoritarianism (Nilsson, 2024), where individuals may still exhibit prejudice towards groups perceived as threats to their ideological beliefs. Conversely, we hypothesized that the aesthetic facet would be the strongest positive predictor of social tolerance. Past research supports this connection, showing that individuals with broad aesthetic tastes are more likely to engage with diverse cultural expressions, fostering greater tolerance for different lifestyles and values (Chan, 2019). Mainly, high scores in the aesthetics facet are linked to more positive attitudes towards diversity (Ng et al., 2021), suggesting aesthetic flexibility reflects not just personal preferences but a broader social ethos that values and embraces both aesthetic and human diversity (Lawn et al., 2023).

Hypothesis 3. [3] Among the sixteen facets analyzed in this study, the facet of liberalism is the most significant negative predictor of prejudice.

Hypothesis 4. [4] Among the sixteen facets analyzed in this study, the facet of aesthetics is the most significant positive predictor of social tolerance.

2. The present research

This paper seeks to contribute to the following three research objectives. Firstly, this paper represents the first known inquiry into the correlation between intergroup attitudes and the diverse conceptualizations of openness. The aim is to demonstrate the significance of facet-specific variance in predicting intergroup attitudes and to identify the criterion relationships between the facets of openness and intergroup attitudes. Secondly, no study has explored whether the relationship between openness and intergroup attitudes observed in the United States is replicable in Southeast Asia (i.e., Singapore), highlighting the need for more research in this region. Research indicates that the link between openness and intergroup attitudes is stronger in Western cultures compared to non-Western cultures (Alper & Yilmaz, 2019). In the United States, where norm violations are more accepted (i.e., loose culture; Gelfand et al., 2011), individuals are more likely to express attitudes that align with their personalities. In contrast, Singapore, characterized as a tight culture (Gelfand et al., 2011), is likely to adopt attitudes that conform more closely to societal expectations than individual personality traits. Consequently, the two studies presented in this paper examine samples from these contrasting cultural contexts, providing further insights into the universality of the relationship between openness and intergroup attitudes. Lastly, the findings from this study will enhance the current theoretical model (i.e., DPM) and contribute to a deeper understanding of the nomological network linking the facets of openness to intergroup attitudes.

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[3] In our preregistration, we originally proposed that several facets of openness, including but not limited to the facet of liberalism, would significantly correlate with prejudice. Upon further consideration, correlation analyses were deemed insufficiently robust to disentangle the unique contribution of each facet. To address this limitation, the analytical approach was refined to multiple regression, which allows for a more precise assessment of each facet's independent predictive value. Consequently, the hypotheses were adapted to align with this method, suggesting that the facet of liberalism would emerge as the strongest predictor of prejudice. This adjustment strengthens the analysis by provided clearer insights into the specific facets of openness most relevant to intergroup attitudes.

[4] Similarly, for social tolerance, we refined our approach by applying multiple regression to isolate the impact of each openness facet. This adjustment allowed us to streamline our hypothesis, specifically positing that aesthetics would be the strongest predictor of social tolerance when analyzed alongside other facets.

3. Study 1

3.1. Method

3.1.1. Participants

Ethics approval was obtained from the authors' institution research ethics Committee (HREC; H8484). In our preregistration,[5] we performed an a priori power analysis using G*Power (Faul et al., 2009) to determine the required sample size. Assuming a medium effect size typical in personality psychology ($f^2 = 0.15$; Anglim et al., 2019; Ekehammar & Akrami, 2007; Han & Pistole, 2017), a sample of 150 participants would provide 95 % power with an alpha of 0.05 to detect significant differences in a multiple regression model with six predictors. The sample in Study 1 consisted of 318 participants: 155 Singapore residents (86 female, 69 male; $M\_age = 39.53$, $SD = 12.78$) and 163 U.S. residents (130 female, 29 male; $M\_age = 44.42$, $SD = 17.00$). A post hoc power analysis was conducted for an exploratory analysis (i.e., hierarchical multiple regression model). Assuming a variance explained by a special effect of 0.12, residual variance of 0.7, $\alpha = 0.05$, $n = 155$, degrees of freedom = 16, and 20 total predictors, the analysis yielded a power of 0.90, indicating that the study had sufficient power for the analysis conducted.

3.1.2. Measures

3.1.2.1. Facets of openness. Facets of openness were assessed using three measures (i.e., IPIP-NEO, SFOS, and HEXACO-PI), which previous studies (i.e., Christensen et al., 2019; Connelly et al., 2014) have identified as representative measures of the facets of openness covering sufficiently both the depth and the breadth of the openness trait. These measures also show measurement invariance across cultures (Lee et al., 2018; McCrae et al., 2005; Woo et al., 2014). The 60-item IPIP-NEO (Goldberg, 1999) openness scale measures six facets of openness, the 54-item SFOS (Woo et al., 2014) measures six facets of openness, and the 32-item HEXACO-PI (Lee & Ashton, 2004) openness subscale measures four facets of openness (Table 1). Items for all three measures (IPIP-NEO, SFOS, and HEXACO-PI) were scored on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Internal consistency for the scales is shown in Table 2.

3.1.2.2. Prejudice. Prejudice against minorities was measured using a feeling thermometer scale, a common practice in the literature (e.g., Asbrock et al., 2010). Specifically, participants were asked to rate how warm their feelings were towards ten culturally relevant target groups, which differed for the Singapore and U.S. samples.[6] Responses ranged from 0 (*very cold or unfavorable feeling*) to 100 (*very warm or favorable feeling*). All responses were reverse scored, where high scores indicated high levels of prejudice. Reliability coefficients were high, with Cronbach's alphas between 0.93 and 0.94 (Table 2).

3.1.2.3. Social tolerance. Social tolerance was measured using the 8-item self-report scale developed by Hjerm et al. (2020; e.g., "I respect other people's opinions even when I do not agree"). The 8-item measure of social tolerance was scored on a five-point Likert scale from 1 (*completely disagree*) to 5 (*completely agree*), where high scores indicate high levels of social tolerance. Cronbach's alphas were between 0.85 and 0.86 (Table 2).

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[5] Preregistration details are available at https://osf.io/mzk9n.

[6] In the Singaporean sample, the analysis included the following ten target groups: Singaporean Malay, Singaporean Indian, Indian immigrants, Filipino immigrants, Hindus, Muslims, lesbian women, gay men, transgender women, and transgender men. In the United States sample, the analysis included the following ten target groups: African Americans, Asian Americans, Latino Americans, Chinese immigrants, Latino immigrants, Muslims, lesbian women, gay men, transgender women, and transgender men.

Table 2

Basic statistics for facets of openness and their correlations with intergroup attitudes in study 1.

Variable	Singapore (*n* = 155)					United States (*n* = 163)				
	α	*M*	*SD*	*R*		α	*Mean*	*SD*	*R*	
				Prej	S. T.				Prej	S. T.
NEO_Openness	0.88	3.23	0.36	−0.27***	0.50***	0.91	3.48	0.46	−0.45***	0.40***
Imagination	0.63	3.33	0.52	−0.12	0.28**	0.80	3.65	0.69	−0.29***	0.28***
Artistic Interests	0.82	3.47	0.68	−0.23**	0.47***	0.79	3.95	0.65	−0.37***	0.42***
Emotionality	0.58	3.33	0.47	−0.19*	0.31***	0.75	3.66	0.64	−0.30***	0.31***
Adventurousness	0.67	3.26	0.52	−0.20*	0.41***	0.76	3.29	0.59	−0.27**	0.22**
Intellect	0.78	3.18	0.60	−0.30***	0.43***	0.82	3.51	0.70	−0.30***	0.34***
Liberalism	0.33	2.84	0.39	<−0.01	0.05	0.72	2.83	0.66	−0.39***	0.14
SFOS_Openness	0.92	3.29	0.42	−0.33***	0.47***	0.94	3.51	0.51	−0.42***	0.42***
Intellectual Efficiency	0.70	3.04	0.53	−0.18*	0.15	0.83	3.21	0.68	−0.10	0.12
Ingenuity	0.80	3.25	0.61	−0.21*	0.41***	0.80	3.46	0.67	−0.26***	0.32***
Curiosity	0.69	3.55	0.52	−0.23**	0.47***	0.77	3.74	0.63	−0.33***	0.41***
Aesthetics	0.83	3.18	0.69	−0.26**	0.39***	0.87	3.58	0.81	−0.35***	0.25**
Tolerance	0.61	3.43	0.48	−0.40***	0.45***	0.71	3.59	0.56	−0.49***	0.53***
Depth	0.44	3.30	0.38	−0.32***	0.34***	0.78	3.46	0.62	−0.41***	0.35***
HEX_Openness	0.86	3.21	0.45	−0.19*	0.44***	0.89	3.42	0.54	−0.39***	0.30***
Aesthetic Appreciation	0.73	3.18	0.64	−0.21**	0.36***	0.74	3.59	0.67	−0.37***	0.26***
Inquisitiveness	0.76	3.34	0.64	−0.16*	0.33***	0.79	3.41	0.74	−0.32***	0.24**
Creativity	0.68	3.14	0.57	−0.05	0.27**	0.77	3.29	0.72	−0.25**	0.18*
Unconventionality	0.50	3.19	0.46	−0.16	0.43***	0.71	3.39	0.60	−0.30***	0.27***
Prejudice	0.94	47.52	23.24	–	−0.25**	0.93	32.83	22.32	–	−0.33***
Social Tolerance	0.86	4.00	0.61	−0.25**	–	0.85	4.02	0.65	−0.33***	–

***p* < 0.001, ***p* < 0.01, and **p* < 0.05.

3.1.2.4. Response quality and demographic items. Following the recommendations of Meade and Craig (2012), two self-reported response quality items ("Do you commit to providing your thoughtful and honest answers to the questions in this survey?" and "You will receive credit for this study no matter what, however, in your honest opinion, should we use your data in our analyses in this study?") were used where participants who indicated "no" for these two items were removed from analyses. Other demographic variables were also measured, such as religion, race, age, gender, educational level, and residential status.

3.1.3. Procedures

The hypotheses and research methodology were preregistered before data collection. Participants were recruited through Qualtrics, an online market research panel. Qualtrics sent email invitations to potential participants in Singapore and the United States, with inclusion criteria of residing in the respective country (Singapore or the United States) and being at least 18 years old. Quota sampling was implemented, using age and educational background quotas based on the 2020 population census for Singapore (Singapore Department of Statistics, 2020) and the United States (data.census.gov). Participants received email invitations and had to read the information sheet and provide consent via a checkbox to complete the online survey. Data quality issues (i.e., speeding, inattentiveness, inconsistent answers, duplications, and bot responding) were automatically screened and removed by the panel provider. Nine out of 164 (5 %) responses from Singapore and eight out of 171 (5 %) responses from the U. S. sample were removed for failing the two response quality items.

3.1.4. Data analysis

All analyses[7] were conducted using SPSS (International Business Machines Corporation, 2021). Multiple regression models[8] were used to

address Hypotheses 1–4. In Model 1, the three openness structures (NEO, SFOS, and HEXACO) were entered as independent variables, with prejudice and social tolerance as dependent variables. Regression coefficients were examined to identify which openness structures most strongly predict each intergroup attitude. Model 2 included the sixteen facets of openness as independent variables to assess not only their predictive strength on prejudice and social tolerance but also whether facet-level variance accounts for intergroup attitudes beyond the broader structures explained in Model 1. Regression coefficients would indicate each facet's unique impact on these attitudes.

3.2. Results

Table 3 displays the standardized regression coefficients (β) for the associations between structures and facets of openness and intergroup attitudes (prejudice and social tolerance) across samples from Singapore and the United States. Model 1, which examines the predictive power of three structures of openness (NEO, SFOS, and HEXACO) on prejudice and social tolerance, explains a substantial amount of variance in both attitudes, with R^2 values ranging from 0.12 to 0.27. In the United States, the NEO openness factor significantly predicts both lower prejudice (β = −0.31, *p* < 0.05) and higher social tolerance (β = 0.25, *p* < 0.05), while SFOS openness shows a strong positive associations with social tolerance (β = 0.39, *p* < 0.01), supporting Hypotheses 1 and 2. Conversely, in the Singapore sample, only the SFOS openness factor (β = −0.38, *p* < 0.01) emerges as a significant negative predictor of prejudice, whereas only the NEO openness factor (β = 0.31, *p* < 0.05) significantly positively predicts social tolerance.

Model 2, which disaggregates openness factors into narrower facets across the NEO, the SFOS and the HEXACO models to examine specific predictive contributions, significantly improves model fit, especially for social tolerance in the U.S. sample (ΔR^2 = 0.19, *p* < 0.001), indicating that facet-level variance adds explanatory power beyond broad factors alone. Interestingly, the facet of liberalism is not the strongest predictor of prejudice in either the U.S. or Singapore samples, contradicting Hypothesis 3. In the Singapore sample, the facet of tolerance emerges as the most significant negative predictor of prejudice (β = −0.33, *p* < 0.01), while unconventionality positively predicts social tolerance (β = 0.25, *p* < 0.01). In the U.S. sample, tolerance remains a significant predictor, with a negative relationship with prejudice (β = −0.30, *p* < 0.01) and a positive relationship with social tolerance (β = 0.50, *p* < 0.001).

Table 3
Standardized coefficients of openness with intergroup attitudes in study 1.

Variable	Singapore (n = 155)		United States (n = 163)	
	β		β	
	Prej	S. T.	Prej	S. T.
Model 1				
Broad Openness Trait				
NEO_Openness	−0.10	**0.31***	**−0.31***	**0.25***
SFOS_Openness	**−0.38****	0.17	−0.11	**0.39****
HEX_Openness	0.17	0.09	−0.07	−0.21
R^2	0.12***	0.27***	0.21***	0.20***
Model 2				
Narrow Facets of Openness				
Imagination	0.06	−0.03	−0.13	0.02
Artistic interests	0.14	0.26	<0.01	**0.30***
Emotionality	−0.01	0.06	<0.01	0.02
Adventurousness	−0.02	0.09	−0.08	−0.04
Intellect	−0.25	0.06	0.09	0.10
Liberalism	0.02	0.03	**−0.22****	−0.13
Intellectual efficiency	−0.05	−0.08	0.06	−0.12
Ingenuity	0.01	0.05	0.04	0.22
Curiosity	0.10	0.24	−0.01	0.14
Aesthetics	−0.25	0.07	−0.01	−0.23
Tolerance	**−0.33****	0.13	**−0.30****	**0.50***
Depth	−0.06	−0.09	−0.13	−0.10
Aesthetic Appreciation	0.03	−0.20	−0.12	0.09
Inquisitiveness	0.03	0.01	−0.05	−0.16
Creativity	**0.25***	−0.09	0.05	−0.19
Unconventionality	−0.03	**0.25****	0.08	0.04
R^2	0.22**	0.38***	0.33***	0.39***
ΔR^2	0.10	0.11	0.12*	0.19***

***p < 0.001, **p < 0.01, and *p < 0.05.

Additionally, the facet of artistic interests positively predicts social tolerance (β = 0.30, p < 0.05), but this effect is observed only in the U.S. sample, providing partial support for Hypothesis 4.

4. Study 2

We conducted a subsequent round of data collection in Study 2, given that the findings only partially supported several hypotheses in Study 1. Notably, we sought to replicate the findings of Study 1 by using the same research methodology but different measures of intergroup attitudes. Accordingly, the hypotheses of Study 2[9] are as follows:

Hypothesis 5. The SFOS Openness factor predicts prejudice and social tolerance better than NEO and HEXACO.

Hypothesis 6. Among the sixteen facets analyzed in this study, the facet of tolerance is a significant negative predictor of prejudice.

Hypothesis 7. Among the sixteen facets analyzed in this study, the facets of artistic interests and the facet of tolerance are significant positive predictors of social tolerance.

4.1. Method

4.1.1. Participants

The ethics amendment for Study 2 received approval from the authors' institution research ethics committee (HREC; H8484). As reported in our preregistration,[10] a priori power analysis (using a multiple regression omnibus F test) indicated that a sample size of 204 would be required for a multiple regression model with sixteen facets of openness as independent variables and intergroup attitudes as dependent

variables ($f^2 = 0.15$, α error = 0.05, power = 0.95, number of predictors = 16). The final sample size is 526, consisting of 300 Singapore residents (147 female, 152 male, and one non-binary) with a mean age of 39.62 (SD = 12.71) and 226 U.S. residents (154 female, 70 male, one non-binary, and one transgender person) with a mean age of 47.73 (SD = 16.96).

4.1.2. Measures

4.1.2.1. Facets of openness.
The facets of openness were assessed using the same measures in Study 1 (i.e., IPIP-NEO, SFOS, and HEXACO-PI). Table 4 describes reliability indices for the internal consistency of the facets of openness.

4.1.2.2. Prejudice.
Prejudice towards minorities was measured using the six-item Attitudes Towards Lesbians and Gays Scale (ATLGS; e.g., "Sex between two men is just plain wrong"; Herek, 1994), the six-item adapted version of the Modern Racism scale (e.g., "Racial minorities are getting too demanding in their push for equal rights"; Poteat & Spanierman, 2012), and the eight-item Modern Sexism scale (e.g., "It is rare to see women treated in a sexist manner on television"; Swim et al., 1995). These measures were selected to capture three aspects of prejudice towards sexual, racial, and gender minority groups, which often load on a single latent variable of prejudice (Levin et al., 2016). Each item was scored on a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The scores for all twenty items were summed and averaged, where high scores indicate high levels of prejudice. Cronbach's alphas were between 0.78 and 0.91 (Table 4).

4.1.2.3. Social tolerance.
Social tolerance was measured using the 15-item Miville-Guzman Universality-Diversity Scale (MGUDS-S; e.g., "I would like to join an organization that emphasizes getting to know people from different countries"; Fuertes et al., 2000). Items were scored on a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*), where high scores indicated high levels of social tolerance. Cronbach's alphas were between 0.76 and 0.82 (Table 4).

4.1.2.4. Response quality and demographic items.
Response quality was evaluated using two self-reported items, as in Study 1. Information was also collected on the demographic variables of religion, race, age, gender, educational level, and residential status.

4.1.3. Procedures

The hypotheses and research methodology for Study 2 were pre-registered before data collection. Participants from Singapore and the United States were recruited via non-probability sampling by dataSpring (https://www.d8aspring.com) and TGM Research (https://tgmresearch.com), respectively. Email invitations were sent to potential participants, with inclusion criteria requiring residency in Singapore or the United States and a minimum age of 18 years. All potential participants read the information sheet, and only those who gave consent to the study and clicked on a checkbox could complete the online survey. Overall, eighty-five out of 611 responses (14 %) were removed for poor data quality: seven responses failed the first response quality item, 23 responses failed the second response quality item, 52 were potential bot-generated responses, and three were identified as duplicate entries.

4.1.4. Data analysis

All analyses[11] for Study 2 were conducted using SPSS (International Business Machines Corporation, 2021), following a similar approach to that employed in Study 1. Multiple regression models were used to test Hypotheses 5–7. In Model 1, the three structures of openness (NEO,

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[9] Because the preregistration for Study 2 was published before new analyses significantly altered Study 1's conclusions, Hypothesis 5 in Study 2 did not fully align with the updated findings. For transparency, we reported the hypothesis as it was originally pre-registered.

[10] Preregistration is available at https://osf.io/zm8uw/.

[11] Raw data are available at https://osf.io/fpu6v/.

Table 4
Basic statistics for facets of openness and their correlations with intergroup attitudes in study 2.

Variable	Singapore (n = 300)					United States (n = 226)				
	α	M	SD	R		α	M	SD	R	
				Prej	S. T.				Prej	S. T.
NEO_Openness	0.86	3.18	0.34	−0.32***	0.67***	0.89	3.31	0.44	−0.56***	0.66***
Imagination	0.65	3.25	0.51	−0.23***	0.39***	0.76	3.41	0.67	−0.36***	0.47***
Artistic Interests	0.80	3.39	0.65	−0.19***	0.58***	0.82	3.72	0.74	−0.38***	0.62***
Emotionality	0.55	3.28	0.46	−0.24***	0.45***	0.69	3.43	0.59	−0.41***	0.49***
Adventurousness	0.59	3.17	0.46	−0.17**	0.54***	0.71	3.16	0.61	−0.25***	0.49***
Intellect	0.73	3.17	0.57	−0.16**	0.55***	0.74	3.37	0.64	−0.29***	0.52***
Liberalism	0.30	2.86	0.38	−0.33***	0.06	0.70	2.76	0.66	−0.53***	0.08
SFOS_Openness	0.90	3.24	0.39	−0.13*	0.70***	0.92	3.37	0.50	−0.43***	0.62***
Intellectual Efficiency	0.70	3.00	0.53	0.04	0.31***	0.77	3.16	0.69	−0.28***	0.17*
Ingenuity	0.68	3.19	0.51	−0.03	0.54***	0.74	3.34	0.65	−0.22**	0.41***
Curiosity	0.69	3.45	0.52	−0.11	0.64***	0.71	3.54	0.63	−0.38***	0.58***
Aesthetics	0.81	3.19	0.68	−0.12*	0.49***	0.82	3.37	0.81	−0.31***	0.56***
Tolerance	0.56	3.38	0.44	−0.17**	0.70***	0.61	3.47	0.55	−0.44***	0.72***
Depth	0.53	3.23	0.43	−0.20***	0.58***	0.57	3.34	0.53	−0.42***	0.53***
HEX_Openness	0.86	3.19	0.44	−0.11	0.58***	0.89	3.28	0.57	−0.26***	0.54***
Aesthetic Appreciation	0.75	3.16	0.63	−0.14*	0.52***	0.73	3.40	0.73	−0.30***	0.52***
Inquisitiveness	0.70	3.31	0.58	0.07	0.48***	0.74	3.35	0.74	−0.17**	0.47***
Creativity	0.69	3.09	0.57	−0.06	0.41***	0.69	3.17	0.68	−0.15*	0.39***
Unconventionality	0.45	3.18	0.44	−0.24***	0.41***	0.60	3.19	0.59	−0.23***	0.42***
Prejudice	0.78	3.13	0.47	–	−0.26***	0.91	2.75	0.78	–	−0.36***
Social Tolerance	0.76	3.43	0.46	−0.26***	–	0.82	3.57	0.59	−0.36***	–

SFOS, and HEXACO) were entered as independent variables, with prejudice and social tolerance as dependent variables. Model 2 then assessed the unique contributions of the sixteen facets of openness, entered as independent variables, to examine their influence on prejudice and social tolerance beyond what was explained by the openness structures in Model 1.

4.2. Results

Table 5 displays the standardized coefficients (β) for the three openness factors and their narrower facets on intergroup attitudes (prejudice and social tolerance) in Study 2 for the samples in Singapore and the United States. The three openness factors (NEO, SFOS, and HEXACO) in Model 1 explain substantial variance with R^2 values ranging from 0.15 to 0.53, underscoring their importance in predicting intergroup attitudes. For participants in Singapore, the NEO openness factor is a strong negative predictor of prejudice (β = −0.60, $p < 0.001$) and a positive predictor of social tolerance (β = 0.29, $p < 0.001$). Among U.S. participants, the NEO openness factor also shows a robust negative association with prejudice (β = −0.77, $p < 0.001$) and a positive link to social tolerance (β = 0.47, $p < 0.001$). While the SFOS openness factor significantly predicts social tolerance in Singapore (β = 0.46, $p < 0.001$), the NEO openness factor consistently emerges as a stronger predictor of intergroup attitudes across samples, suggesting that the predictive strength of SFOS over NEO and HEXACO, as proposed in Hypothesis 5, is not fully substantiated in this study.

Adding facet-level predictors in Model 2 yields a marked increase in explanatory power (Table 5), highlighting that narrower facets offer added insights into intergroup attitudes not fully captured by the broad openness factors. Hypothesis 6 is not supported, as tolerance did not predict prejudice in Singapore. Instead, liberalism emerges as a significant negative predictor of prejudice in Singapore (β = −0.32, $p < 0.001$) and the U.S. (β = −0.54, $p < 0.001$). Hypothesis 7 is partially supported: while artistic interests did not predict social tolerance in Singapore, tolerance emerged as a consistent positive predictor in Singapore (β = 0.36, $p < 0.001$) and the U.S. (β = 0.49, $p < 0.001$).

5. Discussion

The present research represents the first attempt to investigate the relationship between intergroup attitudes and the various

Table 5
Standardized coefficients of facets of openness with intergroup attitudes in study 2.

Variable	Singapore (n = 155)		United States (n = 163)	
	β		β	
	Prej	S. T.	Prej	S. T.
Model 1				
Broad Openness Trait				
1. NEO_Openness	**−0.60***	**0.29***	**−0.77***	**0.47***
2. SFOS_Openness	**0.24***	**0.46***	−0.11	**0.22***
3. HEX_Openness	0.13	0.02	**0.41***	0.01
R^2	0.15***	0.53***	0.37***	0.46***
Model 2				
Narrow Facets of Openness				
Imagination	**−0.17***	0.04	**−0.24***	0.07
Artistic interests	−0.07	0.08	**−0.21***	**0.28***
Emotionality	−0.08	**0.10***	**−0.16***	**0.12***
Adventurousness	0.01	0.05	0.06	**0.23***
Intellect	−0.07	0.05	0.08	0.08
Liberalism	**−0.32***	0.02	**−0.54***	−0.06
Intellectual efficiency	−0.02	−0.09	**−0.21***	**−0.19***
Ingenuity	0.14	**0.13***	0.07	−0.09
Curiosity	0.05	**0.14***	−0.11	0.02
Aesthetics	0.10	−0.06	0.06	−0.01
Tolerance	−0.08	**0.36***	**−0.18***	**0.49***
Depth	**−0.18***	0.04	−0.03	−0.01
Aesthetic Appreciation	−0.09	0.12	0.03	−0.14
Inquisitiveness	**0.20***	0.10	0.05	**0.14***
Creativity	0.13	−0.09	**0.19***	−0.07
Unconventionality	**−0.17***	0.06	0.05	−0.02
R^2	0.28***	0.63***	0.58***	0.66***
ΔR^2	0.13***	0.10***	0.21***	0.20***

***$p < 0.001$, **$p < 0.01$, and *$p < 0.05$.

conceptualizations of openness. Two research questions were used to guide the research process: (a) which facet structure of openness (NEO, HEXACO, and SFOS) best predicts prejudice and social tolerance? and (b) Which specific facet of openness best predicts prejudice and social tolerance? There are three main benefits to doing so. First, our findings further the understanding of the nomological network behind the relationships between the facets of openness and the two distinct intergroup attitudes (i.e., prejudice and social tolerance). Second, the present two studies are the first to examine the link between the facets of

openness and intergroup attitudes in Southeast Asia (i.e., Singapore). This line of investigation contributed further insight into the universality of the link between openness and intergroup attitudes. Lastly, our findings improve the existing theoretical model (i.e., DPM) by identifying the facet structure and facet of openness that best predict prejudice and social tolerance. In the following section, the findings of the two studies will be broadly summarised and discussed per the two research questions outlined above.

5.1. Structures and facets of openness and social tolerance

Across the two studies, the NEO openness factor consistently predicts social tolerance across samples. The SFOS openness factor is also positively associated with social tolerance in both studies but has a stronger effect in Study 2, particularly in Singapore. Facet-level analysis (Model 2) also significantly increases the variance explained in both studies, with stronger increases in Study 2 (Table 5) for social tolerance. The facet of tolerance consistently and strongly predicts social tolerance across studies and samples, showing a stronger association in Study 2 (Table 5) for both Singapore and the U.S., compared to Study 1. Other facets, such as artistic interests, show variable significance across samples. For instance, artistic interests positively predicts social tolerance in the U.S. across both studies, an effect that was weaker or non-significant in Singapore (Tables 3 and 5).

Results suggest the NEO openness factor and the facet of tolerance, both emphasizing variety-seeking, are significant predictors of social tolerance. Aligned with previous studies that reported that the structures of openness vary in their ability to predict attitudes and behaviours (e.g., Anglim et al., 2020), our results highlighted specific openness factor (i. e., NEO) as more important in the prediction of social tolerance than others (i.e., SFOS and HEXACO). Additionally, our results indicated the facet of tolerance as the most robust predictor of social tolerance. These results may not be surprising, as the facet of tolerance (interest in learning about different cultures) captures characteristics that overlap with social tolerance (positive attitude towards diversity). However, it is important to point out that the tolerance facet is robust (Woo et al., 2014) and not synonymous with social tolerance, especially given that the tolerance facet predicts both prejudice and social tolerance and does not fully correlate with social tolerance.

Our findings revealed that the facets of similar themes do not necessarily share equivalent predictive utility. For example, the facet of liberalism, which shared a similar theme with the facet of tolerance, accounted for <1 % of the variance in social tolerance across both studies. The facet of liberalism characterized those who are receptive to new perspectives and, at the same time, ready to challenge traditions, orthodox norms, and authoritative figures. Individuals who score high on the facet of liberalism reject conservative political ideology and religious doctrines and advocate for a more liberal perspective. On the other hand, individuals who score high on the facet of tolerance are those who embrace a variety of attitudes, beliefs, and lifestyles and are comfortable interacting with people who hold different opinions or come from different cultural backgrounds (Woo et al., 2014). These individuals are interested in learning about different customs and traditions and attending cultural events. Many social psychologists (e.g., Brandt et al., 2014) argue that social tolerance is linked with the epistemic motives to maximize understanding and the existential motives to broaden community, as opposed to the epistemic motives to reduce uncertainty and existential motives to minimize ideological threats. This research suggests that one's interest in learning about different cultures (i.e., the facet of tolerance) is more likely to be associated with positive attitudes towards diversity (i.e., social tolerance) than the disposition towards challenging traditional norms and authority figures (i.e., the facet of liberalism).

This research provides new empirical support for the differentiation of prejudice and social tolerance. Pittinsky et al.' (2011) two-dimensional model of intergroup attitudes posited that prejudice and social tolerance are (a) largely independent and (b) preceded by different causal mechanisms. Our findings supported these claims, showing that the two intergroup attitudes were only moderately correlated (Tables 2 and 4), indicating that prejudice and social tolerance are distinct but related constructs (Hjerm et al., 2020). Additionally, prejudice and social tolerance were not always strongly predicted by the same facet of openness. For instance, in Study 2, liberalism best predicted prejudice, while tolerance best predicted social tolerance (Table 5). All these findings suggest that prejudice and social tolerance do not share the same causal mechanism, which is consistent with previous research (e.g., Blais-Rochette et al., 2022).

5.1.1. Structures and facets of openness and prejudice

In this research, the NEO openness factor emerges as a significant negative predictor of prejudice across cultures. In Study 1 (Table 3), this effect is notable in the U.S., while in Study 2 (Table 5), it is much stronger for both the U.S. and Singapore. SFOS openness factor significantly predicts prejudice in both studies but only in Singapore (Tables 3 and 5). Similarly, the HEXACO openness factor's predictive role also varies, with a positive association with prejudice in Study 2's U.S. sample, an effect absent in Study 1.

Across both studies, facet-level analysis (Model 2) consistently enhances the variance explained for prejudice. Notably, this increase in explanatory power to prejudice is even more pronounced in the United States. This pattern highlights the added value of examining openness at the facet level and suggests that specific facets of openness play a critical role in understanding prejudice, particularly in contexts where more nuanced aspects of openness may drive intergroup attitudes. In Study 1 (Table 3), the facet of liberalism emerges as a significant negative predictor for the U.S. sample only, while in Study 2 (Table 5), it is a significant negative predictor in both Singapore and the U.S., showing consistency and stronger effects in Study 2. In contrast, tolerance is a significant negative predictor of prejudice in both cultures in Study 1, but only in the U.S. in Study 2. Our results could not conclusively identify which facet of openness was the strongest predictor of prejudice, possibly due to differences in how prejudice was operationalized in the two studies.

According to psychologists (Correll et al., 2010), prejudice is a multifaceted construct that includes several components related to cognition (e.g., stereotypes), affect (e.g., mistrust or unease), and action (e.g., behavioral distance or discrimination). The feeling thermometer scale, used to examine prejudice in Study 1, measured participants' general evaluations of a social group that is affect-based and without any semantic content (Lin & Alvarez, 2020). In contrast, Study 2 used specific scales, such as the ATLGS (Herek, 1994), the Modern Racism Scale (Poteat & Spanierman, 2012), and the Modern Sexism Scale (Swim et al., 1995), that assessed participants' beliefs regarding minority social groups and reflected the cognitive underpinning of a person's negative group evaluation (Correll et al., 2010). The feeling thermometer scale in Study 1 likely tapped into affective components of prejudice, while the measures in Study 2 addressed cognitive components, each aligning with different structures and facets of openness.

The dual process model (DPM) differentiates prejudice into three types (prejudice against derogated, dissident, and dangerous groups) and links these to ideological motivations: right-wing authoritarianism (RWA) and social dominance orientation (SDO; Asbrock et al., 2010). RWA is associated with prejudice against dissident and dangerous groups due to the fear of social threat (affect-based), while SDO is linked to prejudice against derogated groups based on a desire to maintain social hierarchy and reduce competition (cognitive-based; Asbrock et al., 2010). Thus, DPM classifies prejudice as either affect-based or cognitive-based.

According to DPM, openness influences affect-based prejudice via RWA, while agreeableness influences cognitive-based prejudice via SDO. However, our findings suggest that openness impacts both affect-based prejudice (through tolerance) and cognitive-based prejudice

(through liberalism). There is no theoretical account for why the two aspects of prejudice (affect and cognitive) were strongly predicted by different facets of openness, suggesting that the dual process model may need theoretical refinement. We argue that the facet of tolerance strongly predicts affect-based prejudice, likely due to its emphasis on the variety-seeking aspect of openness, while the facet of liberalism predicts cognitive-based prejudice, likely due to its emphasis on the complex-thinking aspect of openness (Table 1). Future studies should verify these findings and examine how RWA and SDO mediate the relationship between openness structures/facets and aspects of prejudice.

5.1.2. Cross-cultural implications

Past studies have highlighted significant variability in personality and intergroup attitudes across cultures (Fetvadjiev et al., 2018; Kirkland et al., 2022), and our results further suggest that culture shapes how openness structures influence prejudice. For instance, the SFOS openness factor is negatively associated with prejudice in Singapore in Study 1 but not in the U.S. (Table 3), and this effect did not replicate in Study 2 (Table 5). The lack of consistency suggests that the SFOS openness factor may not be a reliable predictor of prejudice across cultures. The HEXACO openness factor also shows inconsistent results where it unexpectedly predicts higher prejudice in the U.S. sample in Study 2, but was not significant for prejudice in Singapore in either study, indicating cultural variations in how the HEXACO openness factor relates to intergroup attitudes. Interestingly, the NEO openness factor consistently predicts lower prejudice across cultures, with a stronger negative association observed in the U.S. sample, particularly in Study 2 (Table 5). This finding suggests that the NEO openness factor, as measured by IPIP-NEO, is a robust predictor of reduced prejudice in Singapore and the U.S., but its effect is more pronounced among U.S. participants.

Our studies are not the first to find that culture moderates the relationship between openness and prejudice (e.g., Roets et al., 2015). These cultural differences may arise from varying exposures to diverse social groups (Kende et al., 2018), emphasis on democratic education (Whitley & Webster, 2019), and differing opinions on group dangerousness (Ahmed et al., 2020). According to DPM, the link between openness and prejudice strengthens when the social situation is perceived as dangerous and threatening. This "dangerous world" perception enhances the importance of collective safety (i.e., RWA), leading low-openness individuals to view minority groups as a societal threat (Duckitt & Sibley, 2010). This may explain the stronger openness-prejudice link in the United States, where participants perceive minorities as a more significant threat than in Singapore. Further cross-cultural studies are needed to identify specific cultural factors, such as threat perception, contact experience, and knowledge of democratic norms, that moderate the openness-prejudice relationship.

5.2. Limitations and future directions

Firstly, most facet scales of openness showed low reliabilities, especially in Singapore, despite previous research indicating satisfactory internal consistencies in Asia and the United States (Lee et al., 2018; McCrae et al., 2005; Woo et al., 2014). The low reliability may be due to the language used in these scales, which might not be entirely appropriate for the Singapore context (McCrae, 2015). For instance, the facet scale of liberalism included phrases reflecting Western political ideologies that may not translate well to Singapore (Rodan, 2012). While some psychologists (e.g., McCrae, 2015) argue that low internal consistency may not significantly affect predictive validity, the low reliability of these openness scales suggests the need for further studies to examine their measurement invariance, particularly in Singapore.

Secondly, methodological artefacts (e.g., restricted response range, reliability coefficient issues, similar response formats) may have contributed to variations in results across samples and studies. Future research could address these method effects using a bi-factor model

(incorporating all three openness structures to fit a latent openness factor and examining specific facet variance for relationships with intergroup attitudes) or multigroup path analysis (nested by countries, openness measures, and intergroup attitudes). Additionally, cultural differences in the salience of ethnic and racial minorities may have affected results. For example, the target groups in Study 1 varied across cultures, and "racial minorities" in Study 2 evoked different groups in the United States versus Singapore (e.g., African Americans vs Filipinos). Future studies could consider measurement invariance studies to ensure that the prejudice construct measured is equivalent across cultures.

Thirdly, the structures examined in this research are psychometric structures of openness, while the scales (i.e., IPIP-NEO, SFOS, and HEXACO-PI) are the operational definition of these structures. As only one questionnaire was used for each structure of openness, any observed differences between structures of openness could reflect differences in the psychometric structures or the specific questionnaires. Convergent evidence from multiple measures of these structures (e.g., NEO-PI-3, HEXACO-PI-R) is needed to draw firm conclusions about psychometric structures.

Fourthly, the lack of individual-level measurement for cultural variables limits our ability to attribute findings to specific cultural sources. While using participants' national origins to make cultural inferences is common practice (Beugelsdijk & Welzel, 2018), future studies should consider measuring specific cultural dimensions (e.g., tightness-looseness). Additionally, non-cultural differences, such as gender proportions, exist between the U.S. and Singapore samples.

Lastly, we emphasized that the terms "predict" and "explain" were not meant to claim causal explanation but instead used throughout this paper in a strictly statistical sense. Rather than implying causation, these findings should be viewed as evidence of convergent validity, demonstrating strong alignment between related constructs (i.e., the facet of tolerance and social tolerance).

5.3. Conclusion

Our studies are the first to identify specific structures and facets of openness that best predict intergroup attitudes: prejudice and social tolerance. Across both studies, the NEO openness factor and the tolerance facet consistently emerged as strong positive predictors of social tolerance, demonstrating robust cross-cultural consistency. For prejudice, the NEO openness factor was also a key negative predictor in both studies, with the tolerance and liberalism facets playing significant roles. This variation may reflect differences in how prejudice was operationalized between studies, underscoring the complexity of capturing intergroup attitudes.

Cultural influences were evident, with openness predicting prejudice more strongly in the U.S. than in Singapore and facet-level analysis providing a more substantial increase in explanatory power in the U.S. than in Singapore. These findings deepen our understanding of the nuanced relationship between openness and intergroup attitudes and suggest that specific cultural factors may amplify or diminish this link. This research highlights the value of a facet-level approach in exploring personality's role in intergroup relations, laying the groundwork for further exploration into cultural moderators of openness and intergroup attitudes.

CRediT authorship contribution statement

Da Xuan Ng: Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Patrick K.F. Lin:** Writing – review & editing, Supervision. **Nigel V. Marsh:** Writing – review & editing, Supervision. **Jonathan E. Ramsay:** Writing – review & editing, Supervision.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2024.112985.

Data availability

The link to the online depository, where data file and code is saved, is made available in the manuscript and has been made anonymised for peer-reviewing.

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