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The Chinese versions of the Interpersonal Needs Questionnaire: Psychometric Properties,
Measurement Invariance across Gender and Cultures

Abstract

Associations between unmet interpersonal needs and different aspects of suicide have been observed in both Western and non-Western cultures using the Interpersonal Needs Questionnaire (INQ). However, measurement invariance is a prerequisite for comparing differences between culturally different groups and to date no studies have examined measurement invariance of INQ across cultures. This study aimed to: (i) validate Chinese versions of the INQ; (ii) assess measurement invariance across gender for the Chinese INQ; (iii) assess measurement invariance across Australian and Chinese cultures for the INQ, and; (iv) comprehensively assess the association of interpersonal needs with suicide ideation. A sample of 469 Australian undergraduates and a sample of 854 Chinese undergraduates were used in this study. For testing measurement invariance across gender, the sample of Chinese undergraduates was split by gender into the Chinese male and Chinese female samples. Five versions of INQ (10-, 12-, 15-, 18- and 25-item) were tested. The 10-item and 15-item Chinese INQ demonstrated adequate psychometric properties through various analyses (i.e., reliability, confirmatory factor analysis, and structural equation modeling) and also demonstrated measurement invariance across gender via multigroup confirmatory factor analysis. The 10-item INQ demonstrated measurement invariance across Australian and Chinese cultures. Of the two interpersonal factors, only perceived burdensomeness was significantly associated with suicide ideation. Multigroup structural equation modeling demonstrated that perceived burdensomeness may be a greater risk factor of suicide among Australian undergraduates than among Chinese undergraduates. Practical and theoretical contributions of this study are discussed.

Keywords: suicide, thwarted belongingness, perceived burdensomeness, assessment, construct validity, reliability

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Suicide is a major public health issue worldwide, accounting for 800 000 deaths by suicide every year (World Health Organization, 2017). This amounts to one person dying by suicide every 40 seconds. Furthermore, for each suicide, there is an estimated twenty or more suicide attempts (World Health Organization, 2017). Suicide is also a widespread public health issue in Asian countries (Snowdon, Chen, Zhong, & Yamauchi, 2018). In particular, there is a recent increase in suicides among Chinese students (Cheng, Chen, Lee & Yip, 2017). For example, suicides among college students in 2016 were almost two times higher than in 2015 (Committee on Prevention of Student Suicides, 2016). The spate of suicides has led to in-depth inquiry into the antecedents of suicide (Cheng et al., 2017) and development of the measures for these antecedents. In particular, this paper aimed to test the psychometric properties and measurement invariance of the Interpersonal Needs Questionnaire (INQ; Van Orden, 2009), for better understanding of the associations between interpersonal needs and different aspects of suicide.

Three commonly cited ideation-to-action theories for understanding suicide are the interpersonal theory of suicide (Van Orden, Witte, Cukrowicz, Braithwaite, Selby, & Joiner, 2010), the integrated motivational-volitional model (O'Connor, 2011; O'Connor & Kirtley, 2018), and the three-step theory (Klonsky & May, 2015). Each of these theories differs with respect to the motivation for suicide, but they all emphasize the significance of interpersonal needs (e.g., belongingness, connectedness, and perception of burden) for addressing suicidal behaviors. For example, in O'Connor's model (O'Connor, 2011; O'Connor & Kirtley, 2018), belongingness and perception of burden are the moderators influencing the development of suicidal ideation or intent from feelings of defeat or humiliation. On the other hand, Klonsky and May's three-step theory (2015) proposes that the co-occurrence of pain and hopelessness leads to suicidal ideation. Pain here refers to psychological or emotional pain caused by sources such as interpersonal conflict (Klonsky & May, 2015), social isolation, perceived

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burdensomeness, and low belongingness (Klonsky, May, & Saffer, 2016). Suicidal ideation is believed to escalate and become active when pain exceeds connectedness to loved and valued ones.

Interpersonal needs also play an essential role in the interpersonal theory of suicide. The interpersonal theory (Joiner, 2005) proposes that the joint frustration of two interpersonal needs (thwarted belongingness and perceived burdensomeness) causes passive suicidal ideation. According to the theory, thwarted belongingness refers to a psychological state resulting from an unmet need for connectedness, which can be operationally defined as social isolation, loneliness, or low levels of perceived social support from others. Perceived burdensomeness refers to the mental state resulting from an unmet need for social competence, which can be reflected by a perception that one is a burden on others or by a sense that others would be better off if the person was gone. Hopelessness about the unchangeability of these states intensifies the passive suicidal ideation into becoming an active desire for suicide. The simultaneous presence of active suicidal desire and capability for suicide is believed to be a sufficient cause of lethal suicidal attempt. A substantial body of research has provided support for the interpersonal theory (for reviews, see Chu et al., 2017; Ma et al., 2016).

Given that frustrated interpersonal needs are implicated in various theories of suicide, a measure assessing interpersonal needs has broad applicability for assessing risk of suicide. The interpersonal needs are primarily assessed using the Interpersonal Needs Questionnaire (INQ) in suicide research (for reviews, see Chu et al., 2017). The INQ was designed to assess an individual's extent of thwarted belongingness and perceived burdensomeness (Van Orden, 2009). The original INQ comprises 25 items with a two-factor structure, 15 items to assess burdensomeness and 10 items for belongingness (Van Orden, 2009). The scale's developers refined the scale to 15 items to reduce multicollinearity between constructs (Van Orden et al.,

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2012). Besides, other versions of the INQ (10, 12, and 18-item) have also been used in previous studies (Hill, Rey, Marin, Sharp, Green, & Pettit, 2015).

All five versions of INQ have been used in Western cultures to demonstrate the associations between interpersonal needs and different aspects of suicide, including suicide risk, suicidal ideation, and suicide attempts (for reviews, see Chu et al., 2017; Ma et al., 2016). The associations between interpersonal needs and suicide have also been found in Asian cultures, including China (Zhang, Lester, Zhao, & Zhou, 2013), Singapore (Teo, Suárez, & Oei, 2018), and South Korea (Chu, Hom, Rogers, Ringer, Hames, Suh, & Joiner, 2016; Suh et al., 2017). Although results from all five versions of INQ have been published, only the 10-item and 15-item English INQ have demonstrated adequate psychometric properties in a psychometric evaluation for all five versions of English INQ (Hill et al., 2015). The INQ has also been psychometrically validated in Asian cultures, for example, Korea (Park & Kim, 2018; Seo, 2018). However, to our knowledge, psychometric validation has yet to be conducted for Chinese translations of INQ. Without information about the psychometric properties of the Chinese translations, researchers cannot be certain that they are tapping into the intended constructs (i.e., interpersonal needs). Furthermore, research indicates that the five English versions of INQ are not equivalent (Hill et al. 2015). As such, differences across versions may affect associations found between interpersonal needs and suicide ideation (Hill et al. 2015). Therefore, there is a pressing need to evaluate Chinese INQ's psychometric properties and concurrent validity of interpersonal needs for suicide ideation.

Gender differences are a further relevant consideration. Mitchell et al. (2019) found that the association between perceived burdensomeness and concurrent desire for death was significantly stronger among men than women when using a sample of American psychiatric outpatients and the 15-item INQ. Zhang et al. (2013) also found that the strength of

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associations between interpersonal needs and suicidal ideation were different for Chinese men and women when using the 18-item Chinese INQ. Unfortunately, however, measurement invariance across gender has not been investigated for Chinese versions of INQ. Since the INQ performed differently according to gender in a Korean study (Seo, 2018), the differences in associations detected in the study of Zhang et al. (2013) might arise from measurement bias between Chinese males and females. On the other hand, no studies to our knowledge have examined measurement invariance of INQ across cultures. Measurement invariance is a prerequisite for comparing differences between culturally different groups and examination of generalizability of a theory across cultures (Milfont & Fischer, 2010). Therefore, examination of measurement invariance across gender and cultures for the INQ is warranted.

This study aimed to address these gaps by undertaking reliability and confirmatory factor analysis (CFA). The convergent and divergent validity was also examined by exploring the associations between interpersonal needs and related constructs, such as social support and self-esteem (Van Orden et al., 2012). This study further examined Chinese INQ's concurrent validity of interpersonal needs for suicide ideation. Measurement invariance across gender and cultures was examined by undertaking a series of multigroup CFA. In addition, this study examined cross-cultural equivalence for the associations of the interpersonal needs with suicide ideation and equivalence across gender for the associations in Chinese cultures.

Method

Participants and Procedures

Participants were 469 undergraduates (male: $n = 102$, 21.7%; female: $n = 367$, 78.3%; mean age = 19.42, SD = 3.25) at a university in Australia and 854 undergraduates (male: $n =$

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457, 53.8%; female: $n = 393$, 46.2%; mean age = 20.02, SD = 1.66) at a university in Hong Kong. Ethical approval was obtained from the Human Subjects Ethics Committee of the Hong Kong Polytechnic University and the Macquarie University Human Research Ethics Committee. Information was provided at the end of the survey for contact details of 24 hour suicide lines and Campus Wellbeing. Australian participants were recruited through an advertisement posted on the online participant pool (SONA) and received course credit for participation. The majority of the participants were born in Australia (Australia: 98.7%, New Zealand: 1.3%). Participants of the Hong Kong sample provided written informed consent and were recruited through three methods (i.e., lecturers' invitation in class, researchers' invitation in workshop, and coaches' invitation in sport training sessions). The majority of the participants were born in Hong Kong and China (Hong Kong: 74.9%, Mainland China: 23.3%). One participant was excluded due to pattern responding (i.e., providing the same answer to most items, including reverse-scored items, and unrealistic answer to items in demographic section).

Measures

The original English versions of all measures were used in the Australian sample. The Chinese versions of all measures were used in the Hong Kong sample. The questionnaires were administered in a paper-and-pencil format for the Hong Kong sample and in an online survey format for the Australian sample. The measures used in this study are presented below according to the order that the measures were presented in the paper-and-pencil questionnaire and the online survey.

The Interpersonal Needs Questionnaire (Van Orden, 2009). The INQ is a 25-item measure of the interpersonal states (10 items for measuring thwarted belongingness and 15 items for measuring perceived burdensomeness). Items are presented with a 7-point Likert

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scale from 1 (not at all true for me) to 7 (very true for me). The 25-item version of INQ was administered in this study. The English INQ has good internal consistency coefficients with Cronbach's $\alpha = .85$ for thwarted belongingness and $\alpha = .89$ for perceived burdensomeness (Van Orden, Witte, Gordon, Bender, & Joiner, 2008). A standard procedure was applied for translation. The authors translated the Interpersonal Needs Questionnaire into Chinese. A professional translator then translated the Chinese translation back into English. The original English questionnaire was then compared item-by-item to the back-translated English version. Discrepancies were identified and adjustments to the Chinese translation were made. The authors then administered the Chinese questionnaire to a small group of Chinese students, whose feedback was incorporated into the final Chinese translation. Reversed items were recoded, so that higher scores reflect higher levels of thwarted belongingness and perceived burdensomeness. Internal consistency of the INQ in this study is reported in the result section.

Rosenberg Self-Esteem Scale (RSE; Rosenberg, 1965, 1979). The RSE is a 10-item measure of self-esteem. Items are presented with a 4-point Likert scale from 1 (strongly disagree) to 4 (strongly agree). The 5 reversed items were recoded, so that higher scores reflect greater self-esteem. The Chinese version of RSE has been extensively used and demonstrated to be a reliable and valid scale (e.g., Lai & Ma, 2019; Zhao, Kong, & Wang, 2012). Internal consistency of the RSE was good in this study ($\alpha_{\text{Chinese}} = .82$).

The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, Dahlem, Zimet, & Farley, 1988). The MSPSS is a 12-item measure of perceived social support from three sources: family, friends, and significant others (support from each source has 4 items). Items are presented with a 4-point Likert scale from 1 (strongly disagree) to 4 (strongly agree), with higher scores reflecting greater perceived social support. Previous studies have demonstrated that the Chinese MSPSS showed good psychometric properties,

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including adequate internal consistency, convergent and divergent validity (e.g., Lai & Ma, 2016; Zhou et al., 2015). Internal consistency of the MSPSS was excellent in this study ($\alpha_{\text{Chinese}} = .90$).

The Scale for Suicide Ideation (SSI; Beck et al., 1979). The SSI is a 21-item measure of suicide ideation and prior suicidal behaviors. Items are presented with a 3-point Likert scale from 0 (a statement describing strong wish to live) to 2 (a statement describing no wish to live). Items 20 and 21 were not used in this study, because they assess prior suicidal behaviors. A total score of suicide ideation was obtained by summing the scores from items 1-19, with higher scores reflecting greater suicide ideation. The English and Chinese versions of the SSI show good reliability and validity (Beck, Steer, & Ranieri, 1988; Zhang & Brown, 2007). Internal consistency of the SSI was good in this study ($\alpha_{\text{English}} = .88$; $\alpha_{\text{Chinese}} = .81$).

Analytic Approach

Prior to factor analysis, normality was assessed both visually and through the Shapiro-Wilk test using the SPSS software. The Shapiro-Wilk test was used because it is considered the most powerful test for symmetric short-tailed distributions, symmetric long-tailed distributions, and asymmetric distributions (Yap & Sim, 2011). All analyses of this study, except Cronbach's α , were conducted in Mplus Version 8 with maximum likelihood estimation robust (MLR) to non-normality because item responses of the INQ (treated as continuously scaled) were not normally distributed. The default, which estimated the model under missing data theory using all available data, was used.

To examine the factorial structures of Chinese INQ, five single-group CFA were conducted using the Hong Kong sample to test the 10-item, 12-item, 15-item, 18-item and 25-item structures. To examine the fit of the five measurement models, several global fit indices were considered. These were the Comparative Fit Index (CFI), the Tucker-Lewis

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Index (TLI), the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), and the chi-square. The chi-square statistic in the analyses with the MLR estimator is the Yuan-Bentler scaled chi-square, which is adjusted for nonnormality. Good model fit is indicated by RMSEA values of .06 or less, SRMR values of .08 or less (Hu & Bentler, 1999), and CFI and TLI values close to .95 or greater (Brown, 2014). Values in the range of .08-.06 for RMSEA suggest reasonable fit (Brown, 2014). In the presence of good fit for other global fit indices, values in the range of .90-.95 for CFI and TLI suggest acceptable fit (Brown, 2014).

To examine internal consistency, Cronbach's alphas were generated for each factor (i.e., thwarted belongingness and perceived burdensomeness) of each measurement model. An alpha of .70 or more indicates good internal consistency (Nunnally & Bernstein, 1994).

The measurement models with acceptable fit and reliability were used in the subsequent analyses to test the validity of Chinese INQ, measurement invariance across gender and cultures, and cross-cultural invariance of the associations between interpersonal factors and suicide ideation.

To examine convergent and divergent validity, single-group structural equation modelling (SEM) using the Hong Kong sample with self-esteem and social support regressed onto the measurement model of Chinese INQ was conducted. According to previous psychometric validation (Van Orden et al., 2012), support for convergent validity could be provided by significant associations (i.e., thwarted belongingness ↔ social support and perceived burdensomeness ↔ self-esteem), while support for divergent validity could be provided by non-significant associations (i.e., perceived burdensomeness ↔ social support and thwarted belongingness ↔ self-esteem). The measurement model of each latent variable (i.e., self-esteem and social support) was tested by single-group CFA to assess the extent to which each of the latent variables was represented by its indicators. The measurement model

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with acceptable fit was considered as the final model of each latent variable and was used in the single-group SEM for examining convergent and divergent validity.

To examine concurrent validity, single-group SEM using the Hong Kong sample with suicide ideation regressed onto the interpersonal factors was conducted for each measurement model (the measurement models resulted from the final single-group CFA).

To examine measurement invariance across gender, the Hong Kong sample was split by gender into a Hong Kong male sample and a Hong Kong female sample. A series of increasingly restrictive multigroup CFAs were conducted with the Hong Kong male sample and Hong Kong female sample. To examine measurement invariance across cultures, a series of increasingly restrictive multigroup CFAs were conducted with the Australian and Hong Kong samples. Prior to measurement invariance analysis, the measurement models of English INQ were tested by single-group CFA, using the Australian sample. Following the stepwise approach discussed in Milfont and Fischer (2010), three models were tested for examining configural, metric, and scalar invariance. The model testing metric invariance was nested in the model testing configural invariance. The model testing scalar invariance was nested in the model testing metric invariance. For model specification, configural invariance was assessed by constraining the factorial structure to be identical across groups. Metric invariance was assessed by constraining all factor loadings to be equal across groups. Scalar invariance was assessed by constraining the intercepts of all items to be equal across groups.

To compare the fit of the models, the fit of the model with identical factor structure served as the basis for comparison to the fit of the model with equal factor loadings. Similarly, the fit of the model with equal factor loadings served as the basis for comparison to the fit of the model with equal intercepts of items. Configural invariance is supported by demonstrating acceptable model fit (according to the global fit indices listed above) for the model with identical factor structure. Metric and scalar invariance was tested by evaluating

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change in CFI (Δ CFI), RMSEA (Δ RMSEA), and SRMR (Δ SRMR) during model comparisons. Change in Satorra-Bentler chi-square (Δ S-B χ^2) is not considered to be the criterion for evaluating change in fit due to the sensitivity of chi-square to large sample sizes (Oishi, 2007). A Δ CFI value smaller than or equal to .01, a Δ RMSEA value smaller than .015, and a Δ SRMR value smaller than .03 indicate that the more restrictive model fits the data as well as the less restrictive one (Chen, 2007; Meade, Johnson, & Braddy, 2008) and supports metric and scalar invariance (Cheung & Rensvold, 2002).

Partial invariance was examined when full metric or scalar invariance could not be established. Partial invariance was examined through an iterative process. First, mis-specified items (i.e., items with differential item functioning across cultures) were identified, guided by modification indices. Second, one item with highest value of modification indices was set freely estimated each time. Third, partial invariance was examined. This procedure was repeated until the criteria of invariance (listed above) were reached.

To examine cross-cultural equivalence and equivalence across gender for the associations of the interpersonal factors with suicide ideation, multigroup SEM with suicide ideation regressed onto the interpersonal factors was conducted for each invariant measurement model resulted from the multigroup CFAs. Wald test for parameter constraints was then performed to compare the structural path coefficients of the samples (Australian and Hong Kong samples for cross-cultural equivalence; Hong Kong male sample and Hong Kong female sample for equivalence across gender). The Wald test was used to examine the null hypothesis that the difference between two parameter estimates is zero. Prior to examining cross-cultural equivalence, a single-group SEM using the Australian sample was conducted for English 10-item INQ.

Results

Descriptive statistics and interrelationship of the INQ items for both Australian and Hong Kong samples are presented in Table 1. The result of the Shapiro-Wilk test (i.e., $p < .001$ for all 25 INQ items) for both Australian and Hong Kong samples suggested responses of the 25 INQ items were not normally distributed. Therefore, estimators that are robust to nonnormality were used.

[Insert Table 1 approximately here]

Internal consistency

To examine the internal consistency of the two subscales (i.e., thwarted belongingness and perceived burdensomeness), Cronbach's coefficient alphas were generated for each subscale and for each measurement model of the Chinese INQ (presented in Table 2). For all five versions, the perceived burdensomeness and thwarted belongingness subscales demonstrated good internal consistency with alphas ranging from .80 to .90.

[Insert Table 2 approximately here]

Confirmatory factor analyses

The measurement model of the 10-item, 12-item, 15-item, 18-item and 25-item INQ were evaluated using the Hong Kong sample by single-group CFA. The initial CFA of all five measurement models did not fit well according to the indices used to evaluate model fit. An uncorrelated factor representing negative wording effects was set and the five models were rerun. The fit statistics are presented in Table 2. The final CFA models of the 10-item and 15-item Chinese INQ demonstrated acceptable to good fit. The final models of the 12-

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item, 18-item and 25-item Chinese INQ did not fit well. The standardized estimated factor loadings and factor correlations of the 10-item and 15-item Chinese INQ are displayed in Table 3. All items significantly loaded onto the specified latent factor ($p < .01$). The standardized loadings ranged from .38 to .90. These results suggest the 10-item and 15-item Chinese INQ adequately measure thwarted belongingness and perceived burdensomeness.

[Insert Table 3 approximately here]

Convergent and divergent validity

The measurement model of self-esteem and social support was tested by CFA and demonstrated acceptable fit (see Table 4). Two SEMs were performed to examine convergent and divergent validity of the 10-item and 15-item Chinese INQ. The fit of each model are presented in the middle of Table 4.

[Insert Table 4 approximately here]

Results supported convergent validity for thwarted belongingness and perceived burdensomeness of the 10-item and 15-item Chinese INQ. Higher perceived burdensomeness was significantly associated with lower self-esteem (10-item: $\beta = -.25, p < .05$; 15-item: $\beta = -.23, p < .05$). Higher thwarted belongingness was significantly associated with lower social support (10-item: $\beta = -.66, p < .01$; 15-item: $\beta = -.81, p < .01$). Results also supported divergent validity for perceived burdensomeness of the 10-item and 15-item Chinese INQ. Perceived burdensomeness was not significantly associated with social support (10-item: $\beta = -.04, p > .05$; 15-item: $\beta = .17, p > .05$). However, the results did not support divergent validity for thwarted belongingness of the 10-item and 15-item Chinese INQ. Thwarted

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belongingness was significantly associated with self-esteem (10-item: $\beta = -.49, p < .01$; 15-item: $\beta = -.45, p < .01$).

Concurrent validity

Two SEMs were performed using the 10-item and 15-item Chinese INQ to examine concurrent validity of interpersonal needs for suicide ideation. The fit of each model are presented in Table 4. Standardized coefficients for the regressions of suicide ideation on thwarted belongingness and perceived burdensomeness appear in Table 5. Perceived burdensomeness of both Chinese INQ was a significant independent predictor of concurrent suicidal ideation. Thwarted belongingness of both Chinese INQs did not significantly predict concurrent suicidal ideation. The SEMs accounted for 10.1% (10-item) and 10% (15-item) of the variance in suicidal ideation scores.

[Insert Table 5 approximately here]

Measurement Invariance across gender

Measurement invariance across gender was evaluated by a series of increasingly restrictive multigroup CFAs. The fit statistics are presented in the middle of Table 2. The configural models of the 15-item and 10-item Chinese INQ demonstrated acceptable fit, providing support to their configural invariance. A decrease in fit statistics for both the 15-item and 10-item Chinese INQ resulted from setting equal factor loadings. However, the change in fit statistics (i.e., $\Delta CFI < .01$, $\Delta RMSEA < .015$, and $\Delta SRMR < .03$) indicated that the metric models of both the 15-item and 10-item Chinese INQ fit the data as well as the configural models. Similarly, an acceptable decrease in fit statistics was resulted from setting equal intercepts for both the 15-item and 10-item Chinese INQ and indicated that the scalar

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models fit the data as well as the metric models. Table 3 shows the standardized estimated factor loadings for the scalar invariant model of the 10-item and 15-item Chinese INQ. These results suggest the measurement models of the 10-item and 15-item Chinese INQ are invariant across gender.

Measurement Invariance across cultures

Table 2 displays the fit statistics for the models testing measurement invariance across cultures. The configural models of the 15-item and 10-item INQ demonstrated acceptable fit, providing support to their configural invariance. Constraints of equal factor loadings did not lead to a significant decrease in fit statistics (10-item: $\Delta\text{CFI} = .006$, $\Delta\text{RMSEA} = .001$, $\Delta\text{SRMR} = .02$; 15-item: $\Delta\text{CFI} = .004$, $\Delta\text{RMSEA} < .001$, $\Delta\text{SRMR} = .018$), providing support to their metric invariance. Constraining of equal item intercepts led to a significant decrease in fit statistics of the 15-item INQ, evidenced by a decrease of .016 in the CFI. Therefore, full scalar invariance was not supported for the 15-item INQ. Partial scalar invariance was tested by releasing the constraint of one item's intercept (i.e., "I have at least one satisfying interaction every day"). As a result, the CFI's decline narrowed ($\Delta\text{CFI} = .01$) and indicated that the assumption of partial scalar invariance held for the 15-item INQ. The partial scalar model of the 15-item INQ demonstrated acceptable fit. For the 10-item INQ, constraining of equal item intercepts did not lead to a significant decrease in fit statistics ($\Delta\text{CFI} = .009$, $\Delta\text{RMSEA} = .005$, $\Delta\text{SRMR} = .003$), providing support for full scalar invariance. The scalar model of the 10-item INQ demonstrated acceptable fit. Table 3 shows the standardized estimated factor loadings for the scalar invariant model of the 10-item INQ. The presence of scalar invariance indicates that the 10-item INQ can be used to examine cross-cultural equivalence for the associations of interpersonal factors with suicide ideation, using the Australian and Hong Kong samples.

Cross-cultural equivalence and equivalence across gender

Prior to the examination of cross-cultural equivalence, a single-group SEM using the 10-item English INQ was performed to test the associations among Australian undergraduates. The fit statistics are presented in Table 4. Standardized coefficients for the structural paths appear in Table 5. Perceived burdensomeness was significantly and positively associated with suicide ideation while thwarted belongingness was not significantly associated with suicide ideation. The SEM accounted for 35% of the variance in suicidal ideation scores.

Since only perceived burdensomeness was significantly associated with suicide ideation among Australian and Hong Kong undergraduates, cross-cultural equivalence was examined for the association of perceived burdensomeness with suicide ideation only. Equivalent association was tested by multigroup SEM with the Wald test function, using the 10-item INQ. The multigroup SEM demonstrated acceptable fit (see Table 4). Standardized coefficients for the structural paths appear in Table 5. Results did not support the equivalence of the association across Australia and Hong Kong. The Wald test was significant, ($\chi^2(1) = 5$, $p < .05$) indicating that the association was significantly different among Australian undergraduates ($\beta = .51$) and Hong Kong undergraduates ($\beta = .21$).

Prior to the examination of equivalence across gender, four single-group SEMs using the 10-item and 15-item INQ were performed to test the associations separately by gender. The fit statistics are presented in Table 4. Standardized coefficients for the structural paths appear in Table 5. The 10-item and 15-item INQ provided similar results. Among Hong Kong male undergraduates, perceived burdensomeness was a significant independent predictor of concurrent suicidal ideation whereas thwarted belongingness was not. The SEMs accounted for 10% (10-item) and 11.6% (15-item) of the variance in suicidal ideation scores.

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Among Hong Kong female undergraduates, both interpersonal factors were not significantly associated with suicide ideation. Therefore, equivalence across gender was not examined.

Discussion

This study aimed to validate Chinese versions of the INQ, test measurement invariance across gender for Chinese versions of the INQ, and test measurement invariance across cultures for the INQ. This study also aimed to comprehensively test the association of interpersonal factor with suicide ideation, using different samples and versions of the INQ. From the five versions of INQ, the 10-item and 15-item Chinese INQ demonstrated adequate psychometric properties through various analyses (i.e., reliability, CFA, and SEM) and further demonstrated measurement invariance across gender via multigroup CFA, in the Hong Kong samples. Of the five versions of INQ, only the 10-item INQ was cross-culturally invariant in the Australian and Hong Kong samples. Of the two interpersonal factors, only perceived burdensomeness was significantly associated with suicide ideation among both Australian and Hong Kong Chinese undergraduates. The strength of the association was significantly stronger among Australian undergraduates than among Chinese undergraduates.

CFA supported the factorial validity for the 10-item and 15-item Chinese INQ. Model fit suggested acceptable fit for both the 10-item and 15-item Chinese INQ. The 10-item and 15-item Chinese INQ also demonstrated excellent reliability. For both Chinese INQ, SEM supported concurrent validity of perceived burdensomeness for suicide ideation, but not thwarted belongingness. Although this finding is inconsistent with the hypothesis of interpersonal theory, it is consistent with the fact that the association between thwarted belongingness and suicidal ideation was not supported in previous studies (for reviews, see Chu et al. 2017; Ma et al. 2016). Researchers have suspected that thwarted belongingness is a less robust risk factor in the development of suicidal thoughts, compared to perceived

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burdensomeness (Chu et al. 2017; Ma et al. 2016). On the other hand, the thwarted belongingness subscale includes items that are reverse-scored. Negative-wording items may not be the exact opposite of directly worded items (Barnette, 2000). Therefore, using mixed items may affect the ability of the thwarted belongingness subscale to adequately capture the association.

SEM supported convergent validity for thwarted belongingness and perceived burdensomeness of the 10-item and 15-item Chinese INQ. SEM also supported divergent validity for perceived burdensomeness of the 10-item and 15-item Chinese INQ. However, SEM demonstrated a significant and negative association of self-esteem with thwarted belongingness and did not support divergent validity for perceived burdensomeness of both Chinese INQ. One explanation may be that self-esteem is associated with loneliness in Chinese culture (Zeng, Ye, Hu, & Ma, 2016), while thwarted belongingness is theoretically related to loneliness (Van Orden et al., 2012). Therefore, this finding may not suggest a lack of divergent validity for perceived burdensomeness, but suggests future research is needed to identify constructs that are unrelated to thwarted belongingness in Chinese cultures for further examination of divergent validity. Taken together, the findings suggest that the 10-item and 15-item Chinese INQ are psychometrically sound measurements for assessing interpersonal needs in Chinese culture.

Multigroup CFA further supported measurement invariance across gender for the 10-item and 15-item Chinese INQ. These findings provide two empirically supported measures for assessing and interpreting differences, or similarities, across gender in the interpersonal factors and their associations with other variables. This study is the first study providing evidence of measurement invariance across gender for Chinese INQ and therefore represents a major contribution to progress in suicide-related research in Chinese culture.

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Multigroup CFA also supported measurement invariance across Australian and Chinese cultures for the 10-item INQ, but not for the 15-item INQ. The 15-item INQ demonstrated partial scalar invariance and had one item with differential item functioning (i.e., “I have at least one satisfying interaction every day”). One explanation may be that the definition of “satisfying interaction” in Chinese culture is different from the definition in Western culture. This may be because social interaction in Chinese culture emphasizes group orientation and reciprocity (Wei & Li, 2013), whereas Western cultures tend to be less interdependent, compared to individuals in East Asian cultures (Lou & Li, 2017; Markus & Kitayama, 2010; Zhu, Zhang, Fan, & Han, 2007). On the other hand, the 10-item INQ does not include this item (i.e., “I have at least one satisfying interaction every day”) (see Table 3). The adequate model fit shows support for scalar invariance and indicates the minimal level of item bias for all items of the 10-item INQ across Australian and Chinese cultures. This is another major contribution to progress in suicide-related research because this finding enables meaningful cross-cultural comparison of the interpersonal factors and their associations with other variables.

This study is also the first to test cross-cultural equivalence for the associations of interpersonal factors with suicide ideation using a cross-cultural equivalent INQ. Results of multigroup SEM indicated that the association of perceived burdensomeness with suicide ideation was not equivalent across Australian and Chinese cultures. The strength of the association among Australian undergraduates was 2.5 times the strength of the association among Chinese undergraduates. This finding suggests that perceived burdensomeness may be a greater risk factor of suicide among Australian undergraduates, compared to Chinese undergraduates. This finding, however, is inconsistent with a previous cross-cultural study (Shu et al., 2017), which found no significant differences in the strength of the associations of the interpersonal factors with suicide risk across South Korea and America. Nevertheless,

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Shu et al. (2017) did not examine measurement invariance across cultures for the INQ. Consequently, similarities between groups could be artifacts of assessments when measurement invariance is not established (Chen, 2008). On the other hand, this study did not test cross-cultural equivalence for the association of thwarted belongingness with suicide ideation because thwarted belongingness was not significantly associated with suicidal ideation among both Australian and Chinese undergraduates. Although the non-significant association was also reported in previous studies (for reviews, see Chu et al. 2017; Ma et al. 2016), studies with a different selection of participants (e.g., a clinical sample) may yield different results because undergraduates generally reported lower levels of suicide ideation than a clinical sample did. For example, using a sample of American psychiatric outpatients, Mitchell et al. (2019) found that both perceived burdensomeness and thwarted belongingness were significantly associated with concurrent desire for suicide. Therefore, more cross-cultural research is needed to examine cross-cultural equivalence for the associations between interpersonal factors and suicide.

This study did not test equivalence across gender because both interpersonal factors were not significantly associated with suicide ideation in the sample of Chinese women. However, gender appears to have an effect on the association of perceived burdensomeness with suicide ideation because perceived burdensomeness was significantly associated with suicide ideation in the sample of Chinese men. Previous studies have also found gender differences in the associations between interpersonal factors and suicidal ideation in Chinese culture (Zhang et al., 2013) and in Western culture (Freedenthal, Lamis, Osman, Kahlo, & Gutierrez, 2011). Since this is the first study using measurement invariant INQ to assess gender difference in Chinese culture, the finding of this study is a valuable addition for the current literature of gender differences in the associations between interpersonal factors and suicidal ideation.

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This study has many strengths, such as the inclusion of a cultural comparison group and the use of multiple analyses. However, this study also has limitations. These include the cross-sectional design and the imbalanced ratio of Australian participants' gender (about 75% of the Australian sample of this study being female). Despite this, a previous study using an American sample has demonstrated measurement invariance across gender for the INQ, (Freedenthal et al., 2011). As such, the imbalance in ratio of gender should not have unduly influenced the findings of this study.

In conclusion, this study aimed to validate Chinese versions of the INQ, test measurement invariance across gender for Chinese versions of the INQ, and test measurement invariance across cultures for the INQ. This study also aimed to comprehensively test the association of interpersonal factor with suicide ideation, using different samples and versions of the INQ. The findings have both practical and theoretical contribution. Practically, this study psychometrically compared five versions of INQ and validated two versions of INQ in Chinese culture. This provides future research a useful reference point for the version of INQ with the most robust psychometric properties in Chinese culture. In addition, this study is the first study establishing measurement invariance across cultures for the INQ and thus enables meaningful cross-cultural comparison of the interpersonal factors and related theories of suicide. Theoretically, this study provides evidence of equivalence across gender for the conceptualization of the interpersonal factors in Chinese culture. This study also demonstrated gender difference in the association between perceived burdensomeness and suicidal ideation. Perceived burdensomeness was significantly associated with suicidal ideation in Chinese men, but not in Chinese women. This finding highlights the critical role of gender in theories of suicide. In addition, our findings indicate that perceived burdensomeness may be a greater risk factor in Western cultures than in Eastern cultures. These findings provide substantial evidence for further

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examination of cultural effect on the associations of interpersonal factors with suicide and thus facilitate refinement of theories of suicide.

Disclosure of conflict of interest

There are no conflicts of interest.

Reference

- Beck, A. T., Kovacs, M., & Weissman, A. (1979). Assessment of suicidal intention: The Scale for Suicide Ideation. *Journal of Consulting and Clinical Psychology, 47*, 343-352. <https://doi.org/10.1037/0022-006X.47.2.343>
- Beck, A. T., Steer, R. A., & Ranieri, W. F. (1988). Scale for suicide ideation: Psychometric properties of a self-report version. *Journal of Clinical Psychology, 44*, 499-505. [https://doi.org/10.1002/1097-4679\(198807\)44:4<499::AID-JCLP2270440404>3.0.CO](https://doi.org/10.1002/1097-4679(198807)44:4<499::AID-JCLP2270440404>3.0.CO)
- Brown, T. A. (2014). *Confirmatory factor analysis for applied research* (2nd ed.). New York, NY: Guilford Press.
- Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling, 14*, 464-504. <https://doi.org/10.1080/10705510701301834>
- Chen, F. F. (2008). What happens if we compare chopsticks with forks? The impact of making inappropriate comparisons in cross-cultural research. *Journal of Personality and Social Psychology, 95*, 1005-1018. <https://doi.org/10.1037/a0013193>
- Cheng, Q., Chen, F., Lee, E. S., & Yip, P. S. (2017). The role of media in preventing student suicides: A Hong Kong experience. *Journal of Affective Disorders, 227*, 643-648. <https://doi.org/10.1016/j.jad.2017.11.007>
- Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*, 233-255. https://doi.org/10.1207/S15328007SEM0902_5
- Chu, C., Buchman-Schmitt, J. M., Stanley, I. H., Hom, M. A., Tucker, R. P., Hagan, C. R., ... & Michaels, M. S. (2017). The interpersonal theory of suicide: A systematic review

VALIDATION OF THE CHINESE INQ

and meta-analysis of a decade of cross-national research. *Psychological Bulletin*, 143, 1313-1345. <https://doi.org/10.1037/bul0000123>

Chu, C., Hom, M. A., Rogers, M. L., Ringer, F. B., Hames, J. L., Suh, S., & Joiner, T. E. (2016). Is insomnia lonely? Exploring thwarted belongingness as an explanatory link between insomnia and suicidal ideation in a sample of South Korean university students. *Journal of Clinical Sleep Medicine*, 12, 647-652. <https://doi.org/10.5664/jcsm.5784>

Committee on Prevention of Student Suicides. (2016). *The Committee on Prevention of Student Suicide(CPSS) - Final Report (Nov 2016)*. Hong Kong: The Education Bureau of Hong Kong. Retrieved from https://www.edb.gov.hk/attachment/en/student-parents/crisis-management/about-crisis-management/CPSS_final_report_en.pdf.

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin*, 52, 281-302. <https://doi.org/10.1037/h0040957>

Freedenthal, S., Lamis, D. A., Osman, A., Kahlo, D., & Gutierrez, P. M. (2011). Evaluation of the psychometric properties of the Interpersonal Needs Questionnaire-12 in samples of men and women. *Journal of Clinical Psychology*, 67, 609-623. <https://doi.org/10.1002/jclp.20782>

Hill, R. M., Rey, Y., Marin, C. E., Sharp, C., Green, K. L., & Pettit, J. W. (2015). Evaluating the Interpersonal Needs Questionnaire: Comparison of the reliability, factor structure, and predictive validity across five versions. *Suicide and Life-Threatening Behavior*, 45, 302-314. <https://doi.org/10.1111/sltb.12129>

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation*

Modeling: A Multidisciplinary Journal, 6, 1-55.

<https://doi.org/10.1080/10705519909540118>

Joiner, T.E. (2005). *Why people die by suicide*. Cambridge, MA: Harvard University Press.

Klonsky, E. D., & May, A. M. (2015). The three-step theory (3ST): a new theory of suicide rooted in the “ideation-to-action” framework. *International Journal of Cognitive Therapy*, 8, 114-129. <https://doi.org/10.1521/ijct.2015.8.2.114>

Klonsky, E. D., May, A. M., & Saffer, B. Y. (2016). Suicide, suicide attempts, and suicidal ideation. *Annual Review of Clinical Psychology*, 12, 307-330. <https://doi.org/10.1146/annurev-clinpsy-021815-093204>

Lai, C. C. W., & Ma, C. M. S. (2016). The Mediating Role of Social Support in the Relationship Between Psychological Well-Being and Health-Risk Behaviors Among Chinese University Students. *Health Psychology Open*, 3, <https://doi.org/10.1177/2055102916678106>.

Lai, C. C. W., & Ma, C. M. S. (2019). Sleep Quality Types and Their Influences on Psychological and Physical Health in Chinese Adolescents: A Person-Centered Approach. *The Journal of Early Adolescence*, 40, 197-220. <https://doi.org/10.1177/0272431619833481>

Lou, N. M., & Li, L. M. W. (2017). Interpersonal relationship mindsets and rejection sensitivity across cultures: The role of relational mobility. *Personality and Individual Differences*, 108, 200-206. <https://doi.org/10.1016/j.paid.2016.12.004>

Ma, J., Batterham, P. J., Calear, A. L., & Han, J. (2016). A systematic review of the predictions of the Interpersonal-Psychological Theory of Suicidal Behavior. *Clinical Psychology Review*, 46, 34-45. <https://doi.org/10.1016/j.cpr.2016.04.008>

VALIDATION OF THE CHINESE INQ

Markus, H. R., & Kitayama, S. (2010). Cultures and selves: A cycle of mutual constitution.

Perspectives on Psychological Science, 5, 420-430.

<https://doi.org/10.1177/1745691610375557>

McDonald, R. P. (1970). The theoretical foundations of principal factor analysis, canonical

factor analysis, and alpha factor analysis. *British Journal of Mathematical &*

Statistical Psychology, 23, 1-21. <https://doi.org/10.1111/j.2044-8317.1970.tb00432.x>

McNeish, D. (2018). Thanks coefficient alpha, we'll take it from here. *Psychological*

Methods, 23, 412-433. <https://doi.org/10.1037/met0000144>

Meade, A. W., Johnson, E. C., & Braddy, P. W. (2008). Power and sensitivity of alternative

fit indices in tests of measurement invariance. *Journal of Applied Psychology*, 93,

568-592. <https://doi.org/10.1037/0021-9010.93.3.568>

Milfont, T. L., & Fischer, R. (2010). Testing measurement invariance across groups:

Applications in cross-cultural research. *International Journal of Psychological*

Research, 3, 111-121. <https://doi.org/10.21500/20112084.857>

Mitchell, S. M., Brown, S. L., Roush, J. F., Tucker, R. P., Cukrowicz, K. C., & Joiner, T. E.

(2019). The Interpersonal Needs Questionnaire: Statistical considerations for

improved clinical application. *Assessment*, 27, 621-637.

<https://doi.org/10.1177/1073191118824660>

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory*. New York: McGraw-Hill.

O'Connor, R. C., & Kirtley, O. J. (2018). The integrated motivational-volitional model of

suicidal behaviour. *Philosophical Transactions of the Royal Society B*, 373,

20170268. <https://doi.org/10.1098/rstb.2017.0268>

O'Connor, R.C. (2011). Towards an integrated motivational-volitional model of suicidal

behavior. In R.C. O'Connor, S. Platt, & J. Gordon (Eds.), *International handbook of*

VALIDATION OF THE CHINESE INQ

suicide prevention: Research, policy, and practice (Vol. 32, pp. 181-198). London: John Wiley & Sons, Ltd.

Oishi, S. (2007). The application of structural equation modeling and item response theory to cross-cultural positive psychology research. In A. D. Ong & M. H. M. Van Dulmen (Eds.), *Oxford handbook of methods in positive psychology* (pp. 126-138). New York, NY: Oxford University Press.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.

Rosenberg, M. (1979). *Conceiving the self*. New York: Basic Books. RE: Krieger.

Snowdon, J., Chen, Y. Y., Zhong, B., & Yamauchi, T. (2018). A longitudinal comparison of age patterns and rates of suicide in Hong Kong, Taiwan and Japan and two Western countries. *Asian Journal of Psychiatry*, *31*, 15-20.

<https://doi.org/10.1016/j.ajp.2017.11.020>

Suh, S., Ebesutani, C. K., Hagan, C. R., Rogers, M. L., Hom, M. A., Ringer, F. B., ... & Joiner, T. E. (2017). Cross-cultural relevance of the Interpersonal Theory of suicide across Korean and US undergraduate students. *Psychiatry Research*, *251*, 244-252.

<https://doi.org/10.1016/j.psychres.2017.02.005>

Teo, D. C., Suárez, L., & Oei, T. P. (2018). Validation of the interpersonal needs questionnaire of young male adults in Singapore. *Plos One*, *13*, e0198839.

<https://doi.org/10.1371/journal.pone.0198839>

Van Orden, K. A. (2009). *Construct validity of the interpersonal needs questionnaire*.

(Unpublished master thesis). The Florida State University.

Van Orden, K. A., Cukrowicz, K. C., Witte, T. K., & Joiner Jr, T. E. (2012). Thwarted belongingness and perceived burdensomeness: Construct validity and psychometric

VALIDATION OF THE CHINESE INQ

- properties of the Interpersonal Needs Questionnaire. *Psychological Assessment*, 24, 197-215. <https://doi.org/10.1037/a0025358>
- Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner Jr, T. E. (2010). The interpersonal theory of suicide. *Psychological Review*, 117, 575-600. <https://doi.org/10.1037/a0018697>
- Van Orden, K. A., Witte, T. K., Gordon, K. H., Bender, T. W., & Joiner Jr, T. E. (2008). Suicidal desire and the capability for suicide: Tests of the interpersonal-psychological theory of suicidal behavior among adults. *Journal of Consulting and Clinical Psychology*, 76, 72-83. <https://doi.org/10.1037/0022-006X.76.1.72>
- Wei, X., & Li, Q. (2013). The Confucian value of harmony and its influence on Chinese social interaction. *Cross-Cultural Communication*, 9, 60-66.
- World Health Organization. (2017). *Suicide data*. Retrieved from http://www.who.int/mental_health/prevention/suicide/suicideprevent/en/.
- Yap, B. W., & Sim, C. H. (2011). Comparisons of various types of normality tests. *Journal of Statistical Computation and Simulation*, 81, 2141-2155. <https://doi.org/10.1080/00949655.2010.520163>
- Zeng, W., Ye, K., Hu, Y., & Ma, Z. W. (2016). Explicit self-esteem, loneliness, and pathological Internet use among Chinese adolescents. *Social Behavior and Personality: an international journal*, 44, 965-972. <https://doi.org/10.2224/sbp.2016.44.6.965>
- Zhang, J., & Brown, G. K. (2007). Psychometric properties of the scale for suicide ideation in China. *Archives of Suicide Research*, 11, 203-210. <https://doi.org/10.1080/13811110600894652>

VALIDATION OF THE CHINESE INQ

Zhang, J., & Brown, G. K. (2007). Psychometric properties of the scale for suicide ideation in China. *Archives of Suicide Research, 11*, 203-210.

<https://doi.org/10.1080/13811110600894652>

Zhang, J., Lester, D., Zhao, S., & Zhou, C. (2013). Suicidal ideation and its correlates: Testing the interpersonal theory of suicide in Chinese students. *Archives of Suicide Research, 17*, 236-241. <https://doi.org/10.1080/13811118.2013.805643>

Zhang, J., Lester, D., Zhao, S., & Zhou, C. (2013). Suicidal ideation and its correlates: Testing the interpersonal theory of suicide in Chinese students. *Archives of Suicide Research, 17*, 236-241. <https://doi.org/10.1080/13811118.2013.805643>

Zhao, J., Kong, F., & Wang, Y. (2012). Self-esteem and humor style as mediators of the effects of shyness on loneliness among Chinese college students. *Personality and Individual Differences, 52*, 686–690. <https://doi.org/10.1016/j.paid.2011.12.024>

Zhou, K., Li, H., Wei, X., Yin, J., Liang, P., Zhang, H., ... & Zhuang, G. (2015). Reliability and validity of the multidimensional scale of perceived social support in Chinese mainland patients with methadone maintenance treatment. *Comprehensive Psychiatry, 60*, 182-188. <https://doi.org/10.1016/j.comppsy.2015.03.007>

Zhu, Y., Zhang, L., Fan, J., & Han, S. (2007). Neural basis of cultural influence on self-representation. *NeuroImage, 34*, 1310-1316.

<https://doi.org/10.1016/j.neuroimage.2006.08.047>

Zimet, G. D., Dahlem, N. W., Zimet, S. G., & Farley, G. K. (1988). The multidimensional scale of perceived social support. *Journal of Personality Assessment, 52*, 30-41.

https://doi.org/10.1207/s15327752jpa5201_2

Table 1

Descriptive statistics and Intercorrelations Among Interpersonal Needs Questionnaire Items for the Hong Kong and Australian samples

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. TB1	-	.67	.68	.67	.56	.46	.47	.47	.54	.46	.57	.24	.29	.52	.31	.32	.36	.33	.37	.27	.44	.46	.41	.34	.33
2. TB2	.66	-	.75	.64	.57	.51	.50	.53	.55	.48	.54	.37	.39	.63	.45	.43	.46	.48	.47	.28	.51	.51	.46	.42	.34
3. TB3	.63	.68	-	.68	.57	.51	.45	.53	.54	.50	.62	.35	.42	.71	.50	.47	.49	.51	.51	.28	.59	.59	.46	.43	.34
4. TB4	.59	.63	.73	-	.60	.45	.50	.46	.58	.49	.57	.27	.31	.53	.38	.35	.33	.38	.43	.28	.45	.44	.41	.32	.37
5. TB5	.47	.52	.52	.52	-	.44	.56	.54	.62	.57	.50	.46	.47	.63	.48	.56	.50	.51	.53	.37	.52	.53	.57	.41	.44
6. TB6	.25	.31	.28	.30	.17	-	.40	.44	.45	.49	.44	.36	.38	.49	.39	.43	.48	.45	.43	.25	.44	.40	.37	.38	.27
7. TB7	.39	.40	.40	.40	.31	.33	-	.36	.65	.69	.38	.44	.44	.43	.45	.49	.43	.47	.50	.24	.41	.44	.43	.39	.29
8. TB8	.37	.34	.40	.41	.42	.24	.27	-	.54	.46	.51	.40	.44	.52	.41	.48	.53	.53	.49	.39	.50	.49	.56	.47	.39
9. TB9	.41	.45	.41	.46	.33	.53	.53	.35	-	.66	.49	.49	.50	.52	.49	.56	.49	.52	.54	.33	.47	.53	.47	.43	.41
10. TB10	.38	.36	.41	.40	.30	.31	.63	.36	.55	-	.44	.52	.56	.51	.56	.59	.52	.58	.62	.25	.55	.51	.47	.55	.35
11. PB1	.49	.47	.56	.56	.44	.19	.39	.35	.31	.39	-	.34	.37	.55	.32	.37	.44	.43	.45	.41	.42	.55	.54	.40	.46
12. PB2	.15	.16	.10**	.10**	.10**	.28	.30	.15	.29	.32	.17	-	.81	.46	.65	.69	.61	.62	.61	.25	.45	.39	.44	.51	.28
13. PB3	.14	.19	.15	.17	.12**	.36	.31	.20	.37	.36	.23	.64	-	.49	.67	.76	.67	.68	.67	.24	.48	.43	.43	.58	.29
14. PB4	.37	.39	.50	.48	.39	.13	.29	.33	.25	.32	.46	.10*	.13**	-	.58	.54	.55	.59	.59	.24	.58	.59	.48	.49	.31
15. PB5	.21	.27	.28	.28	.16	.40	.42	.24	.45	.42	.27	.50	.62	.20	-	.75	.67	.71	.72	.24	.55	.48	.42	.59	.28
16. PB6	.21	.22	.22	.21	.21	.35	.40	.23	.36	.37	.30	.55	.60	.19	.60	-	.70	.71	.70	.25	.53	.51	.47	.56	.34
17. PB7	.24	.26	.22	.22	.18	.45	.43	.24	.46	.42	.26	.37	.49	.22	.47	.48	-	.78	.76	.31	.52	.48	.49	.67	.32
18. PB8	.27	.33	.29	.29	.21	.48	.53	.26	.52	.49	.32	.44	.57	.27	.60	.53	.73	-	.87	.28	.56	.46	.44	.71	.31
19. PB9	.27	.33	.33	.32	.21	.45	.57	.26	.53	.52	.31	.39	.52	.26	.58	.50	.68	.80	-	.28	.57	.46	.42	.73	.32
20. PB10	.27	.22	.24	.26	.30	.11**	.24	.30	.25	.30	.33	.17	.16	.28	.15	.24	.28	.21	.22	-	.27	.40	.53	.25	.77
21. PB11	.30	.33	.43	.40	.31	.28	.28	.37	.33	.36	.33	.18	.23	.45	.29	.20	.35	.38	.37	.38	-	.59	.52	.49	.33
22. PB12	.37	.43	.46	.45	.40	.25	.32	.42	.36	.38	.43	.22	.30	.48	.28	.29	.34	.34	.36	.48	.51	-	.65	.38	.45
23. PB13	.32	.33	.34	.38	.37	.17	.31	.39	.29	.30	.41	.20	.22	.37	.21	.24	.32	.27	.29	.44	.40	.63	-	.37	.61
24. PB14	.18	.26	.23	.23	.17	.38	.41	.19	.46	.50	.24	.36	.49	.22	.49	.43	.58	.63	.62	.23	.30	.31	.22	-	.30
25. PB15	.31	.28	.29	.32	.33	.12**	.27	.33	.27	.32	.35	.19	.15	.32	.15	.24	.28	.21	.21	.61	.26	.44	.45	.22	-
Mean (AU)	2.79	2.32	2.26	2.50	3.02	2.63	3.46	2.49	3.37	2.74	2.45	3.18	2.74	2.47	2.27	2.75	2.19	2.15	2.08	3.58	2.54	3.13	3.09	1.84	3.64
Variance (AU)	2.13	1.95	1.45	2.08	1.92	2.23	3.09	1.80	2.83	2.12	1.32	2.36	2.24	1.45	1.79	2.56	1.96	1.74	1.85	1.78	1.77	1.62	1.95	1.66	2.09
n (AU)	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469	469
Mean (HK)	2.76	2.63	2.74	2.63	3.28	2.56	3.20	3.11	2.72	3.00	2.95	3.53	2.90	3.37	2.73	3.23	2.47	2.42	2.44	3.36	2.80	2.84	2.86	2.18	3.43
Variance (HK)	1.15	1.15	1.05	1.12	1.41	1.44	1.99	1.61	1.51	1.53	1.24	1.66	1.37	1.25	1.32	1.58	1.64	1.41	1.41	1.25	1.26	0.87	1.07	1.26	1.35
n (HK)	853	852	850	851	850	853	851	851	851	852	852	853	851	848	851	853	853	850	853	852	853	853	853	850	852

Note. Correlations for the Hong Kong sample are below the diagonal, and correlations for the Australian sample are above the diagonal.

HK = Hong Kong sample; AU = Australian sample.

All unmarked correlations are significant at $p < .001$. * $p < .05$, ** $p < .01$, and † $p > .05$.

Table 2 Fit Statistics for Single-group and Multigroup Confirmatory Factor Analysis models (CFA)

	Goodness-of-fit indices							Internal consistency (α)	
	χ^2	df	CFI	TLI	RMSEA (90% CI)	SRMR	PB	TB	
Single-group CFA: 10 items (HK)	153.400**	31	.953	.932	.068 (.058 - .079)	.043	.879	.799	
Single-group CFA: 12 items (HK)	398.846**	48	.898	.859	.093 (.084 - .101)	.049	.866	.808	
Single-group CFA: 15 items (HK)	307.831**	83	.951	.938	.056 (.050- .063)	.043	.896	.864	
Single-group CFA: 18 items (HK)	673.975**	126	.904	.883	.071 (.066 - .077)	.054	.873	.864	
Single-group CFA: 25 items (HK)	1508.309**	261	.848	.825	.075 (.071 - .079)	.071	.894	.876	
Single-group CFA: 10 items (HK, male)	103.068**	31	.950	.928	.071 (.056 - .087)	.045	.877	.788	
Single-group CFA: 10 items (HK, female)	81.855**	31	.958	.939	.065 (.048 - .082)	.047	.880	.787	
Single-group CFA: 15 items (HK, male)	207.420**	83	.951	.938	.056 (.050- .063)	.043	.895	.866	
Single-group CFA: 15 items (HK, female)	210.545**	83	.940	.925	.063 (.052- .073)	.050	.897	.855	
Single-group CFA: 10 items (AU)	58.611**	31	.986	.980	.044 (.026 - .060)	.027	.917	.867	
Single-group CFA: 15 items (AU)	222.647**	83	.959	.948	.060 (.050 - .069)	.039	.932	.910	

	Goodness-of-fit indices						Comparison of nested models			
	χ^2	df	CFI	TLI	RMSEA (90% CI)	SRMR	Contrast	Δ CFI	Δ RMSEA	Δ SRMR
Invariance across gender (HK)										
1. Configural invariance: 10 items	185.204**	62	.954	.933	.068 (.057 - .080)	.046	-	-	-	-
2. Metric invariance: 10 items	199.994**	70	.951	.937	.066 (.055 - .077)	.054	2 vs. 1	.003	.004	.008
3. Scalar invariance: 10 items	229.206**	77	.943	.933	.068 (.058 - .078)	.056	3 vs. 2	.008	.004	.002
4. Configural invariance: 15 items	417.941**	166	.946	.932	.060 (.053 - .067)	.049	-	-	-	-
5. Metric invariance: 15 items	433.668**	179	.946	.936	.058 (.051 - .065)	.053	5 vs. 4	.000	.004	.004
6. Scalar invariance: 15 items	470.151**	191	.940	.934	.059 (.052 - .065)	.054	6 vs. 5	.006	.002	.001
Invariance across cultures										
7. Configural invariance: 10 items	211.193**	62	.968	.953	.060 (.052 - .069)	.038	-	-	-	-
8. Metric invariance: 10 items	244.985**	70	.962	.951	.061 (.053 - .070)	.058	8 vs. 7	.006	.001	.020
9. Scalar invariance: 10 items	295.797**	77	.953	.945	.066 (.058 - .074)	.061	9 vs. 8	.009	.005	.003
10. Configural invariance: 15 items	532.385**	166	.954	.942	.058 (.052- .063)	.042	-	-	-	-
11. Metric invariance: 15 items	582.944**	179	.950	.941	.058 (.053 - .064)	.060	11 vs. 10	.004	.000	.018
12. Scalar invariance: 15 items	717.556**	191	.934	.928	.065 (.060 - .070)	.067	12 vs. 11	.016	.007	.007
12a. Partial scalar invariance	674.499**	190	.940	.933	.062 (.057 - .067)	.063	12a vs. 11	.010	.004	.003

Note. * $p < .05$ ** $p < .01$. Robust Maximum Likelihood estimation was used. χ^2 = Satorra-Bentler Chi-Square; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = root mean square error of approximation; CI=confidence interval; SRMR= standardized root mean square residual. α = Cronbach's alpha. TB = thwarted belongingness. PB = perceived burdensomeness.

GENERALIZABILITY OF THE INTERPERSONAL THEORY

Table 3

Standardized Estimated Factor Loadings and Factor Correlations for Single-group/Multigroup CFA models

	Single-group CFA								Multigroup CFA					
	15 items				10 items				15 items		10 items			
	M	F	HK	AU	M	F	HK	AU	M	F	M	F	HK	AU
Thwarted belongingness subscale item														
<i>I am close to other people</i>	.504	.414	.475	.644	.502	.444	.486	.616	.482	.447	.495	.468	.602	.537
<i>I feel that there are people I can turn to in times of need</i>	.545	.489	.529	.699	-	-	-	-	.525	.512	-	-	-	-
<i>Other people care about me</i>	.501	.448	.491	.693	-	-	-	-	.475	.477	-	-	-	-
<i>I am fortunate to have many caring and supportive friends</i>	.509	.509	.520	.682	.519	.537	.534	.665	.519	.503	.529	.521	.650	.573
<i>I feel like I belong</i>	.320	.452	.376	.766	.331	.486	.388	.747	.379	.369	.400	.399	.678	.473
<i>I rarely interact with people who care about me</i>	.600	.643	.622	.609	-	-	-	-	.624	.625	-	-	-	-
<i>I often feel like an outsider in social gatherings</i>	.738	.637	.686	.719	.796	.670	.740	.761	.718	.646	.774	.699	.773	.682
<i>I have at least one satisfying interaction every day</i>	.390	.415	.405	.658	-	-	-	-	.416	.374	-	-	-	-
<i>I feel disconnected from other people</i>	.794	.801	.802	.815	.740	.811	.767	.846	.796	.802	.756	.789	.857	.788
Perceived burdensomeness subscale item														
<i>I think I make things worse for the people in my life</i>	.651	.630	.643	.756	.645	.647	.645	.746	.651	.622	.652	.629	.699	.674
<i>I think the people in my life wish they could be rid of me</i>	.659	.715	.682	.787	.667	.746	.698	.782	.684	.687	.699	.710	.771	.716
<i>I think I am a burden on society</i>	.777	.801	.787	.843	-	-	-	-	.780	.798	-	-	-	-
<i>The people in my life would be happier without me</i>	.904	.906	.904	.923	.897	.874	.892	.921	.899	.912	.890	.888	.925	.878
<i>The people in my life would be better off if I were gone</i>	.879	.853	.871	.923	.886	.853	.876	.935	.879	.854	.884	.858	.936	.875
<i>I think my death would be a relief to the people in my life</i>	.712	.705	.710	.776	.705	.722	.707	.772	.713	.700	.709	.707	.770	.714
Factor correlations	.802	.741	.780	.744	.810	.691	.771	.699	.802	.739	.811	.695	.694	.759

Note. All factor loadings and factor correlations were significant ($p < .01$). HK = Hong Kong sample. AU = Australian sample.

M = Male participants of Hong Kong sample. F = Female participants of Hong Kong sample.

Italicized items are reversed-scored.

Table 4*Fit Statistics for Confirmatory Factor Analysis Models and Single-group/Multigroup Structural Equation Models (SEM)*

	χ^2	<i>df</i>	CFI	TLI	RMSEA (90% CI)	SRMR
“Good fit” indicated by:			≥.95	≥.95	≤.06	≤.08
“Acceptable fit” indicated by:			≥.90	≥.90	≤.08	
Confirmatory Factor Analysis						
Self-Esteem	151.429**	30	.943	.914	.069 (.058 - .080)	.036
Social Support	180.988**	51	.963	.953	.055 (.046 - .063)	.032
Convergent and divergent validity						
Single-group SEM: 15 items (HK)	1755.052**	609	.911	.903	.047 (.044 - .050)	.055
Single-group SEM: 10 items (HK)	1375.549**	447	.912	.902	.049 (.046 - .052)	.049
Associations between the suicide ideation and interpersonal factors						
Single-group SEM: 10 items (AU)	89.650**	38	.977	.966	.054 (.039 - .068)	.030
Single-group SEM: 15 items (HK)	350.750**	95	.946	.932	.056 (.050 - .063)	.044
Single-group SEM: 10 items (HK)	186.742**	38	.946	.922	.068 (.058 - .078)	.043
Single-group SEM: 15 items (HK) (male)	234.365**	95	.948	.934	.057 (.048 - .066)	.047
Single-group SEM: 10 items (HK) (male)	128.418**	38	.942	.917	.072 (.059 - .086)	.046
Single-group SEM: 15 items (HK) (female)	234.990**	95	.936	.919	.061 (.051 - .071)	.050
Single-group SEM: 10 items (HK) (female)	99.591**	38	.950	.928	.064 (.049 - .080)	.046
Structural invariance for the path coefficients between the suicide ideation and interpersonal factors						
Multigroup SEM: 10 items	362.651**	91	.945	.934	.067 (.060 - .075)	.059

Note. CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = root mean square error of approximation; CI=confidence interval; SRMR= standardized root mean square residual; α = Cronbach’s alpha. * p <.05 ** p <.01.
 HK = Hong Kong sample. AU = Australian sample.

Table 5*Associations between suicide ideation and the INQ factors*

Description	Single-group SEM			Multigroup SEM		
	TB	PB	R²	TB	PB	R²
Australian sample: 10 items INQ	.101	.511**	.350	.094	.514**	.347
Hong Kong sample: 10 items INQ	.144	.186*	.101	.127	.205*	.103
Hong Kong sample: 15 items INQ	.044	.267*	.100	-	-	-
Hong Kong sample: 10 items INQ (male)	.020	.286*	.100	-	-	-
Hong Kong sample: 10 items INQ (female)	.218	.170	.134	-	-	-
Hong Kong sample: 15 items INQ (male)	-.103	.395**	.116	-	-	-
Hong Kong sample: 15 items INQ (female)	.173	.190	.124	-	-	-

Note. TB = Thwarted Belongingness. PB = Perceived Burdensomeness. * $p < .05$ ** $p < .01$.