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The Chinese Family Assessment Instrument (C-FAI): Hierarchical Confirmatory Factor Analyses and Factorial Invariance

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Abstract

Objective: This paper examines the dimensionality and factorial invariance of the Chinese Family Assessment Instrument (C-FAI) using multigroup confirmatory factor analyses (MCFA). **Method:** A total of 3,649 students responded to the C-FAI in a community survey. **Results:** Results showed that there are five dimensions of the C-FAI (communication, mutuality, conflict and harmony, parental concern, parental control), which are subsumed under two higher-order factors (family interaction and parenting). Evidence of factorial invariance in terms of configuration, first-order factor loadings, second-order factor loadings, intercepts of measured variable, and intercepts of first-order latent factor, was found. **Conclusions:** The C-FAI is an objective measure of Chinese family functioning with high factorial validity. It can be used in family practice contexts of Chinese families.

Keywords: *Chinese adolescents, family functioning, confirmatory factor analysis, hierarchical factor analysis, factorial invariance*

The Chinese Family Assessment Instrument (C-FAI):

Hierarchical Confirmatory Factor Analyses and Factorial Invariance

A large body of literature demonstrates the influence of family functioning on adolescent adjustment (e.g., Farrington & Loeber, 2000), adolescent psychological well-being (e.g., Henderson, Dakof, Schwartz, & Liddle, 2006) and adult adjustment (e.g., Duncan et al., 1997). However, most of these findings were conducted in western populations and few studies have examined family functioning in non-western populations. With specific reference to the Chinese culture, a computer search of the Social Work Abstracts database in June 2009 using "family functioning" and "Chinese" as search terms showed that there were only two published work in this area.

Previous results showed that the concept of family functioning might vary across cultures (Hohasi, Honda, & Kong, 2008; Morris, 1990; Roncone et al., 1998; Shek, 2001). In the Chinese culture, because of their unique socialization attributes, Chinese people have an "undifferentiated" view about the family as compared to the Western samples (Shek, 1998). To provide effective family treatments and interventions, there is a strong need to help families and clinical practitioners develop multicultural competence (i.e., knowledge and awareness) when working for families with a diverse range of cultural background (Constantine, Gloria, & Ladany, 2002; Sue et al., 1998). This is supported by a recent study which showed that multicultural knowledge and awareness influenced family counselors' bias in their judgment during the family assessment process (Gushue, Constantine, & Sciarra, 2008). Obviously, one basic multicultural competence is how to assess family functioning in different ethnic groups.

A survey of the family literature shows that several family assessment tools are commonly used. These include the Family Assessment Device (FAD; Epstein, Baldwin, & Bishop, 1983), Self-report Family Inventory (SFI; Beavers, Hampson, & Hulgus, 1985), Family

Adaptability and Cohesion Evaluation Scales (FACES-II; Olson et al., 1982), and Family Environment Scales (FES; Moos & Moos, 1981). Though the psychometric properties of these instruments have been supported (e.g., Green, 1989; Tutty, 1995), their cross-cultural validity remains controversial (Aarons, McDonald, Connelly, & Newton, 2007; Morris, 1990; Phillips, West, Shen, & Zheng, 1998; Roncone et al., 1998; Shek, 1998, 2002a).

Researchers highlighted the development of culturally appropriate instruments when assessing family functioning in Chinese families (Kennedy et al., 2004; Shek, 1998). For example, Phillips and colleagues (1998) warned that the lack of family assessment tools has hindered the development of family interventions for Chinese mental patients. Aarons and colleagues (2007) also contended that "it may be prudent to develop a family assessment tool using an alternative, more quantitative approach that allows for tailoring factor structure to specific racial/ethnic groups" (p. 567). Given the size of Chinese population that constitutes roughly one-fifth of the world's population and the increasing demand for family assessment tools in helping different professions (e.g., Kennedy et al., 2004; Simpson, 2005), more work is needed to develop indigenous Chinese family functioning tools in the social work context.

In response to the lack of indigenous Chinese family functioning measures, Shek (2002b) constructed the Chinese Family Assessment Instrument (C-FAI) for assessing family functioning in Chinese populations. According to Shek (2002b), there are five basic dimensions of the C-FAI, including communication, mutuality, conflict and harmony, parental concern and parental control, with the first three aspects related to the concept of "*family interaction*" and the last two aspects related to "*parenting*". Though the dimensionality of the C-FAI was supported via exploratory and confirmatory factor analyses (Shek, 2002b, 2003; Siu & Shek, 2005), there are several limitations in these studies. Firstly, although exploratory factor analytic findings (Shek, 2002b) were good, support for the factor structure of the C-FAI via confirmatory factor analysis was not particularly robust (Siu & Shek, 2005). Secondly, the sample used in Siu and Shek (2005) was based on convenience sampling which limits the generalizability of the findings (Gorsuch, 1974). Thirdly, the hierarchical structure of the C-FAI is not clear. Although communication, mutuality, and conflict and harmony factors are proposed to be subsumed under family interaction whereas parental concern and parental control factors are subsumed under parenting, this conceptualization has not been tested. Finally, factorial invariance of the proposed factor structure has not been examined in previous studies.

In a broader context, it is noteworthy that few researchers have examined the hierarchical structure of family functioning using hierarchical confirmatory factor analysis (HCFA) and few related research initiatives are present in the social work context. A computer search in June 2009 using the search term "second-order (or higher-order or hierarchical) confirmatory factor analysis" showed that there were 35 citations in PsycINFO, whereas there was only one citation in Social Work Abstracts. Similarly, with some isolated attempts (e.g., Kim & Ji, 2009), few studies have examined factorial invariance. When the search term "factorial invariance" was used, there were 346 citations in PsyINFO and 6 citations in Social Work Abstracts. When the term "multigroup (or multisample) confirmatory factor analysis" was used, there were 44 citations in PsycINFO but no citation in Social Work Abstracts. Finally, when the search terms "factorial invariance" and "family functioning" were used, there was no citation in either database. These figures clearly show that there is a strong need to conduct studies on second-order factor analysis and factorial invariance in the social work research context.

In response to the above-mentioned limitations in the literature, there are two objectives of this study. First, the factor structure of the C-FAI was tested via confirmatory factor analysis (CFA). Besides the models involving primary factors, a hierarchical model of the C-FAI based on the conceptual model underlying the C-FAI was examined. Second, factorial invariance of the C-

FAI was examined in terms of factor pattern, factor loadings, and intercepts. The present study utilized the data of Shek (2002b) to perform confirmatory factor analysis to achieve the above two objectives. According to Marsh and Richards (1987), in instruments where there is no clearly defined a priori structure, it would be helpful to use exploratory factor analysis to examine the dimensionality of the scale and then use confirmatory factor analysis to further test the structure based on exploratory factor analysis. As the guiding model for the C-FAI was tentative and the findings based on confirmatory factor analysis by Siu and Shek (2005) are not robust, it is a reasonable strategy to re-analyze the original dataset and to re-examine the dimensionality of the C-FAI using confirmatory factor analysis.

Method

Participants and Procedures

The data collected in Shek (2002b) were used in this study. The participants were 3,649 adolescents in Hong Kong. The participants were Secondary 1 (n = 880), Secondary 2 (n = 898), Secondary 3 (n = 930) and Secondary 4 (n = 941) students. They were selected from Hong Kong secondary schools by using the multiple stage stratified random sampling method, with school banding (i.e., academic ability of the students) as the stratifying factor (Moser & Kalton, 1980). After obtaining the approval of the university institutional review board, a total of 26 schools from different parts of Hong Kong were invited to participate in this study. The participants could be considered as heterogeneous as they came from different areas and socio-economic classes in Hong Kong. The mean age of the participants was 14 years old (SD = 1.4).

During the data collection process, the purpose of the study was mentioned and confidentiality of the collected data was repeatedly emphasized to all students in attendance on the day of testing. The students were asked to indicate their wish if they did not want to participate in the study. All participants responded en masse to all instrument scales in the questionnaire in a self-administration manner. Adequate time was provided for the subjects to complete the questionnaire. A trained research assistant was present throughout the administration process.

Instruments

The Chinese Family Assessment Instrument (C-FAI) was used. The C-FAI is a 33-item self-report instrument developed to assess family functioning. The C-FAI has five subscales, including mutuality (mutual support, love and concern among family members), communication (frequency and nature of interaction among family members), conflict and harmony (conflicting and harmonious behavior in the family), parental concern (parental support behavior), and parental control (harshness of parenting behavior). A higher total score on the subscales indicated a higher level of dysfunction in family functioning. Shek (2002b, 2003; Siu & Shek, 2005) conducted a series of validation studies which examined the factor structure, reliability, concurrent, and discriminant validity of the C-FAI, and showed that the scale was a valid and reliable measure of family functioning. In the study, the participants also responded to other validated measures of family functioning and psychological well-being (Shek, 2002b).

Data Analytic Strategy

Before testing the invariance of model parameters, a preliminary analysis was conducted to check any violations of multivariate normality assumptions as well as skewness and kurtosis values of all items. This preliminary step was important because maximum likelihood estimation method (ML) would only estimate the model correctly under the assumption of multivariate normality of the observed variables (Breckler, 1990; Curran, West, & Finch, 1996).

There were three parts in the data analysis process. First, confirmatory factor analysis (CFA) was conducted to test the theoretical dimensions of the C-FAI. Then, hierarchical confirmatory factor analysis (HCFA) was used to examine the higher-order structure of the C-

FAI (see Figure 1). Second, multigroup confirmatory factor analysis (MCFA) was adopted to examine different factor model features (e.g., factor loadings) across genders. Specifically, a series of measurement invariance tests based on the analysis of means and covariance structures (MACS) was employed. Followed the steps outlined by Byrne and Stewart (2006), the factorial invariance of the instrument was examined in terms of: a) configural invariance, b) first-order factor loadings, c) second-order factor loadings, d) intercepts of the measured variable, and e) intercepts of the first-order latent factor. Widaman and Reise (1997) pointed out that invariance factor loadings and intercepts are adequate to answer most substantive research questions. As a result, invariance of factor uniqueness (error) and latent factor means were not examined in the study. Finally, identical factor analytic procedures mentioned above were carried out to further assess the stability of the factor structure by randomly splitting the total sample into two subsamples (i.e., odd and even groups).

To evaluate the overall fit of the models, several fit indices were employed. These included chi-square (χ^2), root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), standardized mean square residual (SMSR), Bentler-Bonett nonnormed fit index (NNFI), comparative fit index (CFI), and expected cross-validation index (ECVI) (Schumacker & Lomax, 2004; Tanaka, 1993). For GFI, CFI, NNFI, there is a general agreement that the values of .95 or greater indicate a satisfactory fit to the data (Schumacker & Lomax, 2004). The values of both SRMR and RMSEA below .08 and .06 respectively represent acceptable model-data fit (Hu & Bentler, 1999).

As the chi-square difference test becomes bias when sample size increases, changes in CFI (ΔCFI) were employed to determine model fit for factorial invariance (Vandenberg & Lance, 2000). Specifically, the value of ΔCFI less than or equal to .01 suggests that the invariance hypothesis should not be rejected (Cheung & Rensvold, 2002). All analyses were conducted by using the covariance matrices via LISREL 8.80 (Jöreskog & Sörbom, 2006).

Results

All variables were normally distributed (i.e., the univariate skewness and kurtosis values were lower than 2 and 7, respectively) (Chou & Bentler, 1995; Curran et al., 1996; Finney & DiStefano, 2006). Therefore, maximum likelihood estimation (ML) was used. Listwise deletion method was used to deal with data that were assumed to be missing completely at random (MCAR). As a result, the effective sample size was 3, 325 (i.e., the amount of missing data was less than 9% of the data).

Comparison of First- and Second-order Factor Models

Table 1 showed the overall goodness-of-fit indices for the models with primary factors and second-order factors. Among the primary factor models, the five-factor model (Model 3) fitted the data better than the other models (i.e., Model 1 & Model 2), demonstrating the five dimensions of the C-FAI. The high correlations among the factors (ranged from .55-.90, Table 3) suggested the hierarchical structure of the models (Brown, 2006; Marsh & Hocevar, 1985). Therefore, a second-order factor model was tested (Model 4a).

Based on the conceptual framework of the C-FAI (Shek, 2002b; Siu & Shek, 2005), a seven-factor second-order model comprising two higher-order and five lower-order factors (see Figure 1) was tested. This model exhibited adequate fit to the data ($\chi^2_{(489)} = 8670.99$, $p < .01$, CFI = .98, GFI = .84, NNFI = .98, RMSEA = .08, SRMR = .04, EVCI = 3.09, Table 1). All factor loadings were statistically significant ($t > 1.95$, $p < .05$) and ranged from .48 to .86.

Large modification indices (i.e., above 500) were found in three pairs of error covariances (i.e., Item 1 & Item 2; Item 18 & Item 19; Item 25 & Item 26). These parameters were allowed to be free as they belonged to the same factor (see Table 2) as this would help to obtain a well-fitting model especially when testing psychological constructs (Byrne, Shavelson, & Muthén, 1989). The modified model (Model 4b) fitted the data reasonably well ($\chi^2_{(486)} = 5594.82$, $p < .01$, CFI = .99, GFI = .90, NNFI = .98, RMSEA = .06, SRMR = .04, EVCI = 1.92, Table 1) with all factor loadings were significant ($t > 1.95$, $p < .05$) and above .45. In this model, all first-order factors loaded strongly onto the proposed second-order factors (ranged from .68-.97). Particularly, the loadings of communication, mutuality, and conflict and harmony (ranged from .89-.97) on *family interaction* was higher than the loadings of parental control and parental concern on *parenting* (ranged from .68-.81) (Table 2). A hierarchical model was generally preferred when the fit of the higher-order factor model was not worse than its lower-order counterpart as it provided a more parsimonious solution (Bong, 1997; Marsh, Balla, & McDonald, 1988). Therefore, Model 4b was employed in subsequent invariance tests.

To obtain a better understanding of the hierarchical factor structure of the C-FAI, a Schmid-Leiman transformation was used (Schmid & Leiman, 1957). Based on the completely standardized solution and treating the first-order factors as residualized primary factors, the amount of variance of all 33 C-FAI items was explored (Brown, 2006). As shown in Table 4, all items yielded salient loading on the two second-order factors (*family interaction* factor: ranged from .43-.82; *parenting* factor: ranged from .45-.72). Inspection of the residual primary loadings revealed that the magnitude of the factor loadings of all items on communication, mutuality, and conflict and harmony were low (below .30), except 5 items (Item 3, Item 7, Item 12, Item 16 and Item 27). Similar result was shown in the parenting-related items, though the residual primary loadings of these items were slightly higher (above .40). These findings indicated that all 33 C-FAI items could be ascribed to two general indicators—*family interaction* and *parenting*. This conclusion was further supported by the amount of variance which was uniquely accounted for by higher-order factors. Both second-order factors explained higher amount of variance (ranged from 18%-68%) than the residual primary factors did (ranged from 1%-30%) (Table 4).

Invariance Tests across Genders

To examine the stability of the dimensionality of the C-FAI, the second-order factor model (Model 4b) was examined separately for each gender. To attain statistical identification purpose, the variance of items, with factor loadings above .70 (i.e., conflict and harmony: Item 16, mutuality: Item 17, parental concern: Item 22, communication: Item 27, parental control: Item 30, Table 2), from their respective factors was fixed to a value of 1.0.

In Table 1, both models showed adequate fit of the proposed model with the datasets in males (Model 5: $\chi^2_{(486)} = 2537.32$, $p < .01$, CFI = .99, GFI = .90, NNFI = .98, RMSEA = .06, SRMR = .04, EVCI = 1.92) and females (Model 6: $\chi^2_{(486)} = 3907.16$, $p < .01$, CFI = .98, GFI = .87, NNFI = .98, RMSEA = .07, SRMR = .04, EVCI = 2.49). All factor loadings in both models were significant ($t > 1.95$, $p < .05$) and above .40 (Table 2). Given the satisfactory fit of both models, a series of measurement invariance tests were performed across genders.

Prior to test for measurement invariance, a baseline model was requested to show the numbers of factors were equated across groups (Byrne, 1998). No equality constraint was imposed in this model. From Table 5, Model 9 fitted the observed data well ($\chi^2_{(972)} = 6444.48$, $p < .01$, CFI = .98, GFI = .87, NNFI = .98, RMSEA = .06, SRMR = .04, EVCI = 2.23), suggesting the generalizability of the factor pattern across genders (i.e., configural invariance). Therefore, further restricted models for testing invariant factor loadings and intercepts were conducted.

In Model 10, equality constraints were added on the first-order factor loading parameters to test for the invariance of first-order factor loadings. Compared to Model 9, the difference in chi-square test from these two models was statistically significant ($\Delta\chi^2_{(28)} = 46.96$, $p < .05$) (Table 5). However, researchers argued that this criterion was too sensitive to a large sample size (Marsh, 1994; Schumacker & Lomax, 2004) and a complex model structure (Brown, 2006). Therefore, a practical approach (ΔCFI equal to or less than .01) was generally adopted for demonstrating measurement invariance (Byrne & Stewart, 2006; Cheung & Rensvold, 2002). As shown in Table 5, the value of ΔCFI remained unchanged (ΔCFI = 0.0), and thereby suggesting the invariance of all first-order factor loadings across genders.

In Model 11, both first- and second-order factor loadings were constrained to be equal between males and females (i.e., testing for invariance of second-order factor loadings). From Table 5, it showed that the value of ΔCFI remains unchanged (ΔCFI = .00) and the chi-square difference test was significant ($\Delta\chi^2_{(5)} = 33.16$, $p < .05$) when compared to Model 10. These findings indicated that the second-order factor loadings were invariant across genders.

Given all first- and second-order factor loadings were invariant, the test of intercept invariance was allowed to be conducted (Chen, Sousa, & West, 2005). In this form of invariance test, all factor loadings (i.e., first and second-order factor loadings) and the intercepts of all measured variables were constrained to be equal across genders (Model 12). Again, the value of ΔCFI remained unchanged (ΔCFI = .00) and the chi-square difference test was significant ($\Delta\chi^2_{(23)} = 86.99$, $p < .05$) when compared to Model 11, suggesting the intercepts of all measured variables were invariant between males and females (Table 5).

In Model 13, equality constraints were imposed on the first- and second-order factor loadings and the intercepts of measured variables and first-order latent factors. The difference in chi-square test was significant ($\Delta\chi^2_{(5)} = 58.78$, $p < .05$) and the value of ΔCFI remained unchanged (ΔCFI = .00) (Table 5). This demonstrated that the intercepts of all first-order latent factors were invariant across genders.

Invariance Tests across Groups

To further examine the stability of the dimensionality of the C-FAI, the total sample was divided into two subsamples based on the case number (i.e., odd and even groups) and identical invariant test procedures for gender were conducted across subsamples. As shown in Table 1, both models showed adequate fit of the proposed model with the datasets in odd group (Model 7: $\chi^2_{(486)} = 3024.57$, $p < .01$, CFI = .99, GFI = .89, NNFI = .98, RMSEA = .06, SRMR = .04, EVCI = 2.08) and even group (Model 8: $\chi^2_{(486)} = 3261.57$, $p < .01$, CFI = .98, GFI = .88, NNFI = .98, RMSEA = .06, SRMR = .04, EVCI = 2.26). All factor loadings in both models were significant ($t > 1.95$, $p < .05$) and above .45 (Table 2). Therefore, a series of measurement invariance tests were performed across groups.

The goodness-of-fit indices of the baseline model reached an acceptable level (Model 14: $\chi^2_{(972)} = 6286.29$, $p < .01$, CFI = .99, GFI = .88, NNFI = .98, RMSEA = .06, SRMR = .04, EVCI = 2.17, Table 6). This model indicated that the factor pattern was invariant across odd and even groups (i.e., configural invariance). For Model 15, the chi-square difference test was not significant ($\Delta\chi^2_{(28)} = 29.57$, $p > .05$) and the value of ΔCFI remained unchanged (ΔCFI = .00) when compared to Model 14. This result showed that the first-order factor loadings were invariant across groups. Similar to the previous test, the difference in chi-square test (Model 15 vs. Model 16) was not significant ($\Delta\chi^2_{(5)} = 4.75$, $p > .05$) and the value of ΔCFI remained unchanged (ΔCFI = .00). In other words, Model 16 provided evidence for the invariance of the second-order factor loadings across groups. Regarding Model 17, no significant differences were found in both chi-square test ($\Delta\chi^2_{(23)} = 20.31$, $p > .05$) and the value of ΔCFI (ΔCFI = .00) when compared to Model 16. This indicated that the intercepts of all measured variables were invariant across groups. Finally, when Model 17 was compared to Model 18, the insignificant results of both chi-square difference test ($\Delta\chi^2_{(5)} = 2.18$, $p > .05$) and the value of ΔCFI (ΔCFI = .00) indicated that the intercepts of first-order latent factors were invariant across groups.

In summary, the findings of the present study demonstrated the existence of the five dimensions of the C-FAI. As shown in Table 3, Cronbach's alpha coefficients for all five factors were in the high range (above .75 in all cases) and the mean inter-item correlation coefficients were acceptable (ranged from .38-.62). Nevertheless, the second-order factor model of the C-FAI showed a better fit than did the primary factor models. The two second-order factors appeared to be two valid indicators of general family functioning. Through a series of invariance tests across participants' genders and case numbers, factorial invariance of the higher-order factor model in terms of configural invariance, first-order factor loadings, second-order factor loadings, intercepts of measured variable, and intercepts of first-order latent factor was supported.

Discussion and Applications to Social Work

The objectives of this study were to examine the dimensionality of the Chinese Family Assessment Instrument (C-FAI) via hierarchical confirmatory factor analysis (HCFA) and to investigate the factorial invariance of the related models. Utilizing the data set collected by Shek (2002b), the findings supported the conceptual framework underlying the C-FAI with five aspects (i.e., communication, mutuality, conflict and harmony, parental concern and parental control) which are subsumed under two constructs of "*family interaction*" and "*parenting*". The findings arising from this validation study are generally encouraging and robust. It was noteworthy that all CFA and HCFA models of the present study yielded better results in terms of goodness-of-fit indices when compared to previous work (Siu & Shek, 2005). One possible factor contributing to this discrepancy is that the sample utilized in this study was larger and randomly drawn from secondary schools in Hong Kong.

Results also clearly showed that the subscales based on the primary factors are internally consistent. Given the common misuse of alpha coefficient (Helms, Henze, Sass, & Mifsud, 2006; Schmitt, 1996), additional information, such as sample size, subscale inter-correlations, averaged inter-correlation among observed variables, and reliability coefficients for each subscale is included in the text and Table 3. Furthermore, the intercepts of all measured variables and first-order latent factors were shown to be invariant across genders and groups which provides evidnece on scalar invariance (i.e., equality of measuremnt intercepts, Meredith, 1993; Vandenber & Lance, 2000) or tau-quivalence (i.e., same units of measurement, Brown, 2006). To examine the scale reliability of a multi-dimensional instrument, it is not only important to satisfy the assumption of tau-equivalence (Raykov, 1997a, 1997b), but also to show the invariance of uniqueness (Vandenberg & Lance, 2000), However, the test of residual invariance has rarely been considered due to its stringent requirement that are difficult to achieve (Byrne et al., 1989; Widaman & Reise, 1997) . Additionally, as invariance of reliability measures is beyond the scope of the present work, this test was not performed.

There are two implications of the present findings as far as social work practice is concerned. First, in view of the paucity of research findings regarding instruments assessing psychosocial functioning in Chinese people (Shek, 2002b), the use of the C-FAI can enable Chinese social workers to assess Chinese family functioning in Chinese and non-Chinese contexts in an objective manner. With the substantial increase in Chinese families in North America, the scale is also valuable for social workers working with American Chinese families. In their review of the development of evidence-based practice in Hong Kong, Shek, Lam and Tsoi (2004) pointed out that there was an urgent need to develop more objective outcome measures in different Chinese communities. Simpson (2005) similarly highlighted that health care professionals should "build a knowledge base to design meaningful culturally sensitive interventions… to examine concepts derived in the Western society to fit in … Chinese people before superimposing them on findings in Chinese populations" (p. 682). Obviously, the present attempt is a constructive response to such suggestion. Furthermore, with increasing demand for accountability and service effectiveness in social work (Thyer, 1989; Thyer & Kazi, 2004), development of the C-FAI can enable social workers and allied professionals to assess family functioning in Chinese families in a more systematic manner. The assessment results can assist social workers and allied professionals to design relevant intervention plans and strategies.

The second implication of the findings is that the subscales based on the C-FAI can be constructed to look at specific aspects of family functioning in a detailed manner. With the growing emphasis on family interventions and increasing demand for family assessment tools for helping different professions (e.g., Halvorsen, 1991; Kennedy et al., 2004; Reichertz & Frankel, 1993; Simpson, 2005), the information based on the subscales of the C-FAI would enhance the understanding of family social workers and practitioners regarding different aspects of family functioning in the clients. For example, while Chinese people might show mutual concern in their families, they might have difficulty in communication, over-emphasis of the importance of harmony, and avoidance of conflicts in the family (Shek, 2001, 2002a).

Finally, the present findings demonstrate the importance of performing hierarchical confirmatory factor analysis and factorial invariance. Methodologically speaking, there are several advantages of testing second-order factor models (Brown, 2006; Chen et al., 2005; Gustafsson & Balke, 1993). Firstly, hierarchical models provide a more parsimonious way of showing the inter-correlations among lower-order factors, and suggest a simple way of understanding the complex measurement structure. Secondly, hierarchical models remove random measurement error from specific factors and indicate the unique amount of variance accounted for by the lower-order factors not shared by the higher-order factors. Finally, hierarchical models demonstrate whether the pattern of relationships among the lower-order factors could be explained by the higher-order factors. As the use of both hierarchical confirmatory factor analysis and factorial invariance is not widespread in social work research, more related work should be done. Specifically, social work educators should make sure that graduate students in social work should know how to perform the related analyses.

Although this study has generated findings which are quite robust, there is a need to assess the generalizability of the findings in different samples in different Chinese communities. Besides, the question of whether the present observations can be replicated in Chinese people living in non-Chinese contexts (e.g., Chinese Americans) remains to be explored. Second, because there are findings suggesting that adolescents and their parents have different perceptions of the functioning of their families (Feldman & Gehring, 1988; Shek, 2001), data on the dimensionality of the C-FAI based on parents with adolescent children should also be collected.

Another criticism of the present study is that both exploratory factor analyses (EFA) and confirmatory factor analyses (CFA) were based on the same dataset. There are three responses to this criticism. First, as the conceptual model for the C-FAI was tentative, it makes sense to start with exploratory factor analysis first (Shek, 2002b). However, as the findings of Siu and Shek (2005) were not particularly robust, it is reasonable to re-analyze the data of Shek (2002b) using confirmatory factor analysis to further understand the dimensionality of the C-FAI. Actually, this approach was recommended by researchers in the field (Marsh & Richards, 1987). Second, by splitting the total sample into two subsamples (i.e., genders and random groups), the stability of the factor structure was adequately examined in this study.

Finally, it is not uncommon to see in the literature that both exploratory and confirmatory factor analyses were performed for the same dataset: Phan and Deo (2008) used EFA and CFA to examine the factor structure of the Study Process Questionnaire; Shiozaki et al. (2008) developed and validated a 7-item bereaved family regret scale through EFA and CFA; McCracken and Thompson (2009) examined the dimensionality of the 15-item Mindful Attention Awareness Scale via the above two factor analyses. In short, it can be argued that the use of the original dataset for CFA was justified and factorial invariance based on a hierarchical factor model for the C-FAI was supported in this study.

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Table 1

Summary of Goodness of Fit for all CFA and HCFA models

Model	Description	χ^2	df	CFI	GFI	NNFI	RMSEA	SRMR	ECVI
1	1-factor model	15649.23**	495	.96	.76	.96	.10	.05	5.39
2	2-factor model	13958.71**	494	.97	.78	.96	.10	.05	4.81
3	5-factor model	9309.92**	485	.98	.85	.98	.08	.04	3.02
4a	Second-order model	8670.99**	489	.98	.84	.98	.08	.04	3.09
4b	Second-order model with 3 pairs of error covariance correlated	5594.82**	486	.99	.90	.98	.06	.04	1.92
5	Males	2537.32**	486	.99	.90	.98	.06	.04	1.92
6	Females	3907.16**	486	.98	.87	.98	.07	.04	2.49
7	Odd group	3024.57**	486	.99	.89	.98	.06	.04	2.08
8	Even group	3261.57**	486	.98	.88	.98	.06	.04	2.26

Note. $N_{total\ effective\ sample}$=3,325; n_{males}=1,516; $n_{females}$=1,809; n_{odd}=1,668; n_{even}=1,657. CFA = confirmatory factor analysis; HCFA = hierarchical confirmatory factor analysis; CFI = comparative fit index; GFI = goodness-of-fit index; NNFI = Bentler-Bonett nonnormed fit index; RMSEA = root mean square error of approximation; SRMR= standardized root mean square residual; ECVI = expected cross-validation index.

$^{**}p < .01$.

Table 2

Completely Standardized Factor Loadings and Uniqueness for the models

	Model 4b				Model 5 (males)				Model 6 (females)				Model 7 (odd)				Model 8 (even)			
	First-order		Second-order		First-order		Second-order		First-order		Second-order		First-order		Second-order		First-order		Second-order	
	FL	U	FL	D	FL	U	FL	D	FL	U	FL	D	FL	U	FL	D	FL	U	FL	D
Communication			.92	.16			.91	.18			.92	.15			.91	.18			.93	.14
Item 7	.74	.46			.66	.56			.79	.38			.72	.48			.75	.44		
Item 8	.62	.62			.59	.65			.63	.60			.62	.62			.61	.62		
Item 9	.76	.43			.73	.47			.78	.40			.75	.44			.76	.42		
Item 10	.73	.47			.71	.50			.75	.44			.73	.46			.73	.47		
Item 11	.70	.51			.67	.55			.72	.49			.69	.52			.70	.50		
Item 25	.70	.51			.67	.56			.72	.48			.70	.51			.70	.51		
Item 26	.74	.45			.73	.47			.75	.44			.76	.42			.71	.49		
Item 27 [a]	.79	.37			.77	.41			.81	.35			.79	.37			.79	.38		
Item 28	.69	.52			.69	.53			.70	.51			.71	.50			.68	.54		
Mutuality			.97	.05			.97	.05			.97	.06			.98	.04			.97	.07
Item 1	.79	.37			.78	.40			.80	.35			.78	.39			.80	.36		
Item 2	.82	.32			.81	.34			.83	.31			.81	.34			.84	.30		
Item 4	.75	.43			.74	.45			.77	.41			.74	.45			.77	.41		
Item 5	.81	.34			.79	.37			.83	.32			.80	.37			.82	.32		
Item 6	.69	.53			.64	.59			.72	.48			.66	.57			.72	.48		
Item 15	.85	.28			.82	.32			.86	.25			.85	.29			.85	.28		
Item 17 [a]	.84	.29			.82	.32			.86	.27			.84	.30			.85	.28		
Item 18	.76	.42			.74	.45			.78	.40			.74	.45			.78	.40		
Item 19	.74	.46			.70	.51			.77	.41			.72	.48			.75	.43		
Item 20	.78	.39			.76	.42			.79	.37			.76	.42			.80	.36		
Item 21	.79	.38			.77	.41			.80	.35			.78	.39			.80	.37		
Item 32	.54	.71			.54	.71			.55	.70			.54	.71			.54	.71		

Note. All parameters were significant ($p < .05$). FL = completely standardized factor loading; U = uniqueness; D= disturbance.

[a] Item was fixed to a value of 1.0.

Table 2 (*continued*)

	Model 4b				Model 5 (males)				Model 6 (females)				Model 7 (odd)				Model 8 (even)			
	First-order		Second-order		First-order		Second-order		First-order		Second-order		First-order		Second-order		First-order		Second-order	
	FL	U	FL	D	FL	U	FL	D	FL	U	FL	D	FL	U	FL	D	FL	U	FL	D
Conflict & Harmony			.89	.20			.88	.22			.90	.19			.88	.22			.90	.18
Item 3	.71	.50			.70	.52			.72	.48			.71	.50			.71	.50		
Item 12	.71	.50			.70	.51			.72	.48			.72	.48			.70	.51		
Item 13	.55	.70			.55	.69			.55	.69			.56	.68			.54	.71		
Item 14	.51	.74			.44	.81			.57	.68			.48	.77			.54	.71		
Item 16 [a]	.81	.35			.78	.39			.82	.32			.81	.34			.80	.36		
Item 33	.48	.77			.47	.78			.48	.77			.48	.77			.47	.78		
Parental concern			.81	.35			.82	.32			.78	.39			.80	.36			.81	.34
Item 22 [a]	.89	.26			.86	.26			.87	.25			.87	.25			.85	.27		
Item 23	.71	.50			.68	.54			.73	.47			.70	.51			.71	.50		
Item 24	.82	.32			.83	.31			.81	.34			.82	.33			.82	.32		
Parental control			.68	.54			.68	.54			.67	.55			.70	.52			.65	.57
Item 29	.73	.47			.72	.48			.73	.47			.74	.45			.71	.50		
Item 30 [a]	.75	.44			.72	.48			.77	.41			.75	.44			.75	.44		
Item 31	.66	.56			.67	.55			.65	.57			.68	.54			.65	.58		

Note. All parameters were significant ($p < .05$); FL = completely standardized factor loading; U = uniqueness; D= disturbance.

[a] Item was fixed to a value of 1.0.

Table 3

Correlation Coefficients, Mean of Inter-item Correlations and Cronbach's Alpha Coefficients among Factors

	α	Mean inter-item correlation	1	2	3	4	5
1. Communication	.90	.52	.-				
2. Mutuality	.94	.58	.90	-			
3. Conflict & Harmony	.78	.38	.79	.87	-		
4. Parental concern	.83	.62	.71	.73	.71	-	
5. Parental control	.78	.38	.58	.60	.67	.55	-

Note. All parameters were significant ($p < .05$).

Table 4

Higher-order Factor Loadings and Residualized Primary Loadings for Model 4b

	Residual primary loading (% of variance)	Higher-order factor loading (% of variance)
Communication		
Item 7	0.30 (9%)	0.68 (46%)
Item 8	0.25 (6%)	0.57 (33%)
Item 9	0.30 (9%)	0.70 (49%)
Item 10	0.29 (9%)	0.67 (45%)
Item 11	0.28 (8%)	0.64 (41%)
Item 25	0.28 (8%)	0.64 (41%)
Item 26	0.30 (9%)	0.68 (46%)
Item 27 [a]	0.32 (10%)	0.73 (53%)
Item 28	0.28 (8%)	0.63 (40%)
Mutuality		
Item 1	0.18 (3%)	0.77 (59%)
Item 2	0.18 (3%)	0.80 (63%)
Item 4	0.17 (3%)	0.73 (53%)
Item 5	0.18 (3%)	0.79 (62%)
Item 6	0.15 (2%)	0.67 (45%)
Item 15	0.19 (4%)	0.82 (68%)
Item 17[a]	0.19 (4%)	0.81 (66%)
Item 18	0.17 (3%)	0.74 (54%)
Item 19	0.17 (3%)	0.72 (52%)
Item 20	0.17 (3%)	0.76 (57%)
Item 21	0.18 (3%)	0.77 (59%)
Item 32	0.12 (1%)	0.52 (27%)
Conflict & Harmony		
Item 3	0.32 (10%)	0.63 (40%)
Item 12	0.32 (19%)	0.63 (40%)
Item 13	0.25 (6%)	0.49 (24%)
Item 14	0.23 (5%)	0.45 (21%)
Item 16 [a]	0.36 (13%)	0.72 (52%)
Item 33	0.21 (5%)	0.43 (18%)
Parental concern		
Item 22 [a]	0.53 (28%)	0.72 (52%)
Item 23	0.42 (18%)	0.58 (33%)
Item 24	0.49 (24%)	0.66 (44%)
Parental control		
Item 29	0.54 (29%)	0.50 (25%)
Item 30 [a]	0.55 (30%)	0.51 (26%)
Item 31	0.48 (24%)	0.45 (20%)

Note. Loadings transformed based on Schmid-Leiman method.

[a] Item was fixed to a value of 1.0.

Table 5

Summary of Goodness of Fit for Gender Invariance Tests

Model	Description	χ^2	df	CFI	GFI	NNFI	RMSEA	SRMR	ECVI	$\Delta\chi^2$	Δdf	ΔCFI
9	Configural invariance (Baseline model)	6444.48**	972	.98	.87	.98	.06	.04	2.23	-	-	-
10	First-order factor loadings invariant	6491.38**	1000	.98	.87	.98	.06	.04	2.23			
	Difference between Model 9 and Model 10									46.96*	28	.00
11	Second-order factor loadings invariant	6523.66**	1005	.98	.87	.98	.06	.057	2.24			
	Difference between Model 10 and Model 11									33.16*	5	.00
12	Measured variable intercepts invariant	6610.65**	1028	.98	.87	.98	.06	.057	2.29			.
	Difference between Model 11 and Model 12									86.99*	23	00
13	First-order intercepts invariant	6669.42**	1033	.98	.87	.98	.06	.057	2.31			
	Difference between Model 12 and Model 13									58.78*	5	.00

Note. CFA=confirmatory factor analysis; CFI = comparative fit index; GFI = goodness-of-fit index; NNFI = Bentler-Bonett nonnormed fit index; RMSEA = root mean square error of approximation; SRMR= standardized root mean square residual; ECVI = expected cross-validation index; $\Delta\chi^2$ = change in goodness-of-fit χ^2 relative to previous model; Δdf = change in degree of freedom relative to previous model; ΔCFI= change in comparative fit index relative to previous model. Model 9 = no equality constraint was imposed; Model 10 = equality constraints were imposed on all first-order factor loadings; Model 11 = equality constraints were imposed on all first- and second-order factor loadings; Model 12 = equality constraints were imposed on all first- and second-order factor loadings, intercepts of the measured variable; Model 13 = equality constraints were imposed on all first- and second-order factor loadings, intercepts of the measured variable and first-order latent factor.

* $p < .05$, ** $p < .01$.

Table 6

Summary of Goodness of Fit for Subsample Invariance Tests

Model	Description	χ^2	df	CFI	GFI	NNFI	RMSEA	SRMR	ECVI	$\Delta\chi^2$	Δdf	ΔCFI
14	Configural invariance (Baseline model)	6286.29**	972	.99	.88	.98	.06	.040	2.17	-	-	-
15	First-order factor loadings invariant	6315.75**	1000	.99	.88	.98	.06	.041	2.16			
	Difference between Model 14 and Model 15									29.57	28	.00
16	Second-order factor loadings invariant	6320.22**	1005	.99	.88	.98	.06	.044	2.16			
	Difference between Model 15 and Model 16									4.75	5	.00
17	Measured variable intercepts invariant	6340.53**	1028	.99	.88	.98	.06	.044	2.19			
	Difference between Model 15 and Model 17									20.31	23	.00
18	First-order intercepts invariant	6342.70**	1033	.99	.88	.98	.06	.044	2.19			
	Difference between Model 17 and Model 18									2.18	5	.00

Note. CFA=confirmatory factor analysis; CFI = comparative fit index; GFI = goodness-of-fit index; NNFI = Bentler-Bonett nonnormed fit index; RMSEA = root mean square error of approximation; SRMR= standardized root mean square residual; ECVI = expected cross-validation index; $\Delta\chi^2$ = change in goodness-of-fit χ^2 relative to previous model; Δdf = change in degree of freedom relative to previous model; ΔCFI= change in comparative fit index relative to previous model. Model 14 = no equality constraint was imposed; Model 15 = equality constraints were imposed on all first-order factor loadings; Model 16 = equality constraints were imposed on all first- and second-order factor loadings; Model 17 = equality constraints were imposed on all first- and second-order factor loadings, intercepts of the measured variable; Model 18 = equality constraints were imposed on all first- and second-order factor loadings, intercepts of the measured variable and first-order latent factor.

** p <.01.

Figure caption

Figure 1. A hypothesized higher-order factor model of the C-FAI.

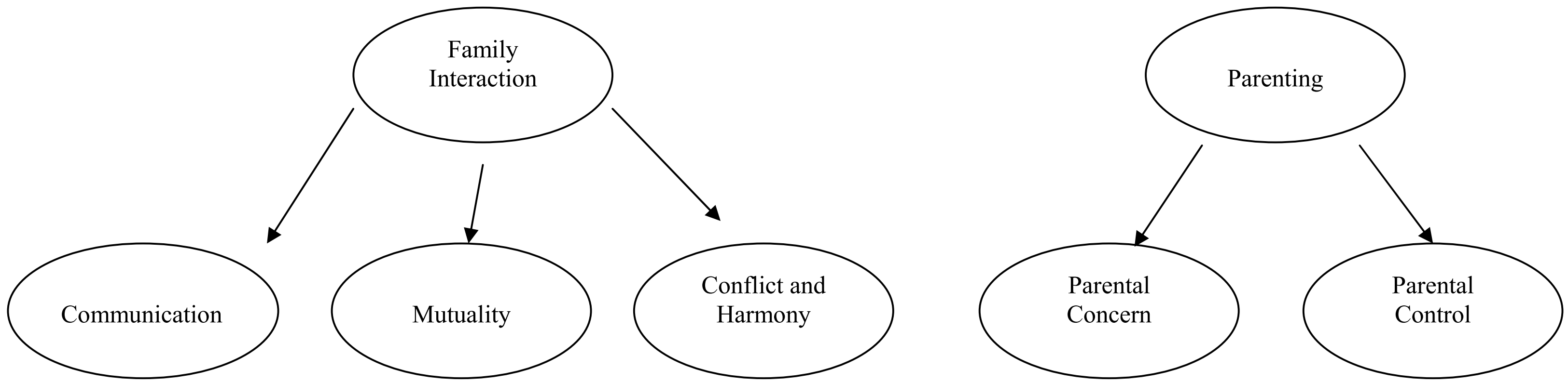

Figure 1. A Hypothesized Higher-order Factor Model of the C-FAI.