RUNNING HEAD: SELF-DIRECTED SEARCH

Psychometric Properties of the Chinese Self-Directed Search (1994 Edition)

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Abstract

In this study we (a) examined the measurement equivalence/invariance (ME/I) of the Chinese Self-Directed Search (SDS; 1994 edition) across gender and geographic regions (Mainland China vs. Hong Kong), (b) assessed the construct validity of the Chinese SDS using Widaman's (1985, 1992) MTMM framework, and (c) determined whether vocational interests are measured equivalently by Chinese SDS subtests. Confirmatory factor analyses suggested that males and females from Mainland China and Hong Kong interpreted the instrument in conceptually similar manner. Also, the Chinese SDS demonstrated sound construct validity. However, we found that like-named interests were not measured equivalently by the SDS subtests.

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Holland's (1973, 1985a, 1997) theory of vocational choices posits that people can be categorized by six personality types: Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C). These six types are arranged in RIASEC order to form a circular order structure; that is, the relations among the types are inversely proportional to the distances among them. Holland's theory also proposes that vocational environments can likewise be classified into these same six types. According to Holland's theory, people tend to seek environments that that are compatible with their needs, values, and general personality traits. People who have higher levels of congruence between their personality types and work environments are more likely to have higher levels of job satisfaction and longer tenure at their jobs. In contrast, incongruence is associated with greater likelihood of job dissatisfaction, poor performance, and job change (Chartrand & Walsh, 1999; Morris, 2003). To date, Holland's theory has demonstrated good cross-cultural validity in Chinese samples. Research generally supports the congruence and circular order hypotheses; that is, people with different interest types seek corresponding environments and the six interest types are formed in a circular order as specified by Holland's theory (e.g., Farh, Leong & Law, 1998; Yang, Stokes & Hui, 2005; Yu & Alvi, 1996).

In order for Holland's theory to provide vocational guidance for Chinese people, there is a need for a psychometrically sound interest inventory in Chinese. The Self-Directed Search (SDS; Holland, 1994) is one of the most widely used instruments measuring Holland's six vocational interest types through five content domains: Activities, Competencies, Occupational Preferences, Self-ratings of Abilities I, and Self-ratings of Abilities II. Research supports the cost-effectiveness and efficiency of the SDS (Srsic, Stimac & Walsh, 2001). However, to our knowledge, the Chinese version of this instrument has not been validated. The purpose of the present study was to examine the psychometric properties of the Chinese SDS (1994 Edition).

The first issue addressed in this study was the measurement equivalence/invariance (ME/I) of the Chinese SDS across populations in Mainland China and Hong Kong. Establishing measurement equivalence across populations is a critical issue for researchers. According to Vandenberg and Lance (2000), demonstration of ME/I is a logical prerequisite to the evaluation of substantive hypotheses regarding group differences. That is, if between-group comparisons are based on non-equivalent measures, interpretations of group differences may be highly suspect. Specifically, the question posed here was whether there are language and gender differences that preclude responding to the Chinese SDS in similar ways across gender and geographic locations in China. People in Mainland China speak Mandarin Chinese, which has a somewhat different grammar and vocabulary from Cantonese, the mother tongue for people in Hong Kong. Whether these language differences would cause respondents in Mainland China versus Hong Kong to interpret the Chinese SDS differently was, prior to the present study, unknown. In terms of gender effects, some research shows that males score higher on Realistic and Investigative interests, whereas females score higher on Artistic and Social interests (Holland, 1985b, 1997) and other research suggests gender difference in terms of the fit of the Hexagon model (e.g., Fouad, Harmon & Borgen, 1997; Glidden-Tracey & Greenwood, 1997; Haverkamp, Collins & Hansen, 1994). Whether these comparisons are based on non-equivalent interpretation of the inventory or actual differences in level and structure of equivalent responses between males and females was also unknown.

The second purpose of this study was to examine the construct validity of the Chinese SDS using a quasi-multitrait-multimethod (MTMM) approach. Previous studies examining the factor structure of the SDS generally provided support for a six factor structure; however, these six factors have not corresponded to the original six vocational interests asserted by Holland. For example, Tuck and Keeling (1980) found that the Social and Enterprising interests were not distinguishable for males and females, and the Investigative and Realistic interests combined as a single factor for the females. In another study, a confirmatory factor analysis demonstrated that the SDS measures six factors: Realistic, Investigative, Artistic, Social-Enterprising (combined), Conventional, and a sixth general interest factor (Rachman, Amernic & Aranya, 1981). Reflecting on these findings, Oosterveld (1994) proposed that in predicting the six factors, the researchers were possibly looking for the wrong structure: the SDS not only measures the six vocational interests, but further encompasses the five domains to measure these traits. This structure resembles the MTMM design (Campbell & Fiske, 1959) in which the vocational interests are the traits and the domains are the methods. Oosterveld (1994) compared the MTMM model and the six-factor model of the SDS (1971 edition and 1985 edition) data. The fit indices obtained from the MTMM model were generally higher than those obtained from the six-factor model for both 1971 and 1985 editions of the SDS.

It is now widely accepted that confirmatory factor analysis is the preferred quantitative model for analyzing MTMM data. In particular, Widaman (1985, 1992) specified a taxonomy of 16 hierarchically nested structural CFA models for MTMM data that are obtained from all possible combinations of four trait structures (Model 1: no Trait factors, Model 2: one general Trait factor, Model 2': *t* uncorrelated Trait factors, and Model 3: *t* correlated Trait factors) and four method structures (Model A: no Method factor, Model B: one general Method factor, Model B': *m* uncorrelated Method factors, and Model C: *m* correlated Method factors). As Widaman explained, each combination of these Trait and Method factor structures produces the

16 CFA models contained in his taxonomy (e.g., Model 2B' hypothesizes one general Trait factor and *m* uncorrelated Method factors; Model 3C hypothesizes *t* correlated Trait factors and *m* correlated Method factors). As we explain later, comparisons among a subset of these models can be conducted to test for convergent validity, discriminant validity, and the presence of measurement method variance. Dumenci (1995) used these hierarchically nested structural models to investigate the MTMM structure of the English SDS (1985 edition) and found that the complete model (Widaman's model 3C) fit better than the other models and provided support for both the convergent and discriminant validity of the SDS. We also adopted Widaman's (1985, 1992) framework to examine the construct validity of the Chinese SDS.

The third purpose of this study was to determine whether each vocational interest is measured equivalently by the five domains. As mentioned previously, the SDS is designed to measure Holland's six vocational interests through five domains (which resembles the MTMM design). According to the MTMM literature (Campbell & Fiske, 1959; Lance, Nobel, & Scullen, 2002; Widaman, 1992), in an MTMM design, where method effects are controlled, each trait (i.e., vocational interest) should be measured equivalently by the different methods (i.e., Activities, Competencies, Occupational Preferences, Self-ratings of Abilities I, and Self-ratings of Abilities II). However, previous research on the SDS has suggested that this may not be the case. Specifically, it has been suggested that the Competencies and Self-ratings of Abilities subtests represent *cognitive* elements of the SDS that assess people's estimates of their own competencies and abilities, whereas the activities and the Occupational Preferences subtests represent *affective* elements of the SDS that assess people's preferences for certain activities and occupations (Rachman et al, 1981; Tuck & Keeling, 1980). As such, the former two subtests are somewhat dependent on the occupation (environment) that people are in, as each occupation emphasizes different competencies and abilities and the environment the individuals are in can bestow them with certain competencies and abilities. The Activities and Occupational Preferences subtests, on the other hand, are less dependent on the environment because they assess people's genuine preferences for certain activities and occupations regardless of the environment the individuals interact with. Based on these findings, we tested the following seven models:

Model A: Like-named traits are measured differently throughout the five domains

Model B: Like-named traits are only measured equivalently by the Activities and Occupational Preferences domains

Model C: Like-named traits are only measured equivalently by the Self-rating of Abilities I and II domains

Model D: Like-named traits are only measured equivalently by the Competencies, Self-ratings of Abilities I and Self-ratings of Abilities II domains

Model E: Like-named traits are measured equivalently by the Activities and Occupational Preferences domains, and they are also measured equivalently by the Self-rating of Abilities I and II domains

Model F: Like-named traits are measured equivalently by the Activities and Occupational Preferences domains, and they are also measured equivalently by the Competencies, Self-ratings of Abilities I and Self-ratings of Abilities II domains

Model G: Like-named traits are measured equivalently by all the five domains

In summary, the purposes of this study were to (a) assess the ME/I of the Chinese SDS across gender and populations in Mainland China and Hong Kong, (b) use Widaman's (1985, 1992) taxonomy of CFA models to test the construct validity of the Chinese SDS, and (c) determine whether each vocational interest is measured equivalently by the different domains (subtests) in the Chinese SDS.

Method

Participants

The sample consisted of 801 participants, 528 from Hong Kong and 273 from Mainland China. In the Hong Kong sample, 203 were males (38.4%) and 325 were females (61.6%). In the Mainland sample, 150 (54.9%) were males and 123 (45.1%) were females. Respondent ages ranged from 18 to 50 years.

The SDS

The SDS is a 228-item instrument designed to assess how closely individuals identify with each of the six Holland interest types and is comprised of five sections: Activities, Competencies, Occupational Preferences, Self-rating of Abilities I, and Self-rating of Abilities II.

The Activities subtest assesses whether a person likes or dislikes particular RIASEC activities. Individuals respond “like” if they feel they would like to do a given activity or “dislike” if they are indifferent or would dislike doing a given activity. Sample items include “work on a scientific project” (an Investigative activity), and “learn strategies for business success” (an Enterprising activity). There are 66 items in this section (6 scales, 11items per scale).

The Competencies section assesses the degree to which respondents feel competent in doing particular tasks, indicating “yes” to tasks which they feel they can do well, and “no” to those they feel they would perform poorly. Samples items include “I can play a musical instrument” (an Artistic competency) and “I am a good public speaker” (an Enterprising competency). There are 66 items in this section (6 scales, 11items per scale).

The Occupational Preferences section assesses individuals' preferences and attitudes regarding the listed occupations. Individuals indicate "yes" to occupations that they are interested in or "no" if they dislike the occupations. Sample items include Sociologist (a Social occupation) and Bank Teller (a Conventional occupation). There are 84 items in this section (6 scale, 14 items per scale).

The Self-ratings on Abilities sections include two sets of self-ratings on abilities and skills. Participants rate their own abilities as high, average, or low on 7-point scales compared to other people in general. Sample items include mathematic ability (an Investigative ability) and mechanical skills (a Realistic skill). There are a total of 12 items in this section.

Holland (1997) reported internal consistency for SDS summary scales ranging from .86 to .92. The SDS Technical Manual also reports a substantial amount of research suggesting that the SDS has stable measurement properties and adequate construct, concurrent, and predictive validity. The English SDS was translated into Chinese by a bilingual Chinese graduate student in Psychology. After being verified by an educational psychologist, the Chinese version of the SDS was back translated to English by a second bilingual Chinese graduate student in Psychology. The same educational psychologist verified the back translation again to make sure that the Chinese version retains the meaning and format of the English version. Coefficient alpha for the Chinese version of the SDS ranged from 0.88 to 0.92 in the current study.

Procedure

Participation invitations were put on two websites in Mainland China and Hong Kong. We promised prospective participants that they would receive detailed feedback on their vocational interests. Participants clicked on a link to a website to respond to the Chinese SDS. At the end of the session, they provided their demographic information and email addresses. Participants were later sent the feedback on their vocational interests via email.

Analysis

Scores for the 30 variables (i.e., the six traits measured by the five methods) were obtained separately from Mainland males, Mainland females, Hong Kong males and Hong Kong females. Interested readers can request copies of SDS subscale scores from the first author. These scores were correlated to get the four MTMM matrices for further analysis.

ME/I across geographic regions and gender was examined using multisample CFA as described by Cole and Maxwell (1985) and Vandenberg and Lance (2000), to compare MTMM covariance structures across groups. We used the LISREL 8.53 program to conduct the CFAs. The overall chi-square statistic was used to assess model fit, but since it is very sensitive to sample size and model complexity, we looked at several other fit indices as well, including Bentler's (1990) comparative fit index (CFI), the Tucker-Lewis index (TLI - values above .95 suggest acceptable fit for the CFI and TLI, see Hu & Bentler, 1999), the root mean squared error of approximation (RMSEA - values less than .06 represent a reasonable fit), and the standardized root mean squared residual (SRMSR - values less than .08 indicate good fit).

A subset of Widaman's (1985, 1992) 16 hierarchically nested models was used to examine the construct validity of the Chinese SDS, although we report model goodness-of-fit for all 16 models for completeness. Depending on the model specification (i.e., the particular combination of Trait and Method factor structure tested), each subscale in the MTMM matrix was restricted to load on only one Trait factor and/or one Method factor, the Trait factors were either correlated or uncorrelated with each other, as were the Method factors (the correlations between trait and method factors were always restricted to zero). For example, in Widaman's Model 3C (which specifies *t* correlated Trait factors and *m* correlated Method factors) each variable was specified as loading only on its corresponding Trait and Method factors (e.g., Realistic interest as measured in the Activities domain was specified as loading on a corresponding Realistic Trait factor and an Activities Method factor), and the Trait and Method factors were specified as being mutually correlated. The aforementioned fit indices were used to assess the Chinese SDS's convergent validity, discriminant validity, method effect, and method discriminability, as is described in more detail later.

Finally, we contrasted seven different models (Models A through G, discussed earlier) to determine whether the like-named traits were measured equivalently across different methods. Depending on the model specifications, certain factor loadings in the pattern matrix were constrained to be equal to each other. For example, tests of Model B involved, for each RIASEC dimension separately, constraining the Activities Method factor loading equal to the Occupational Preferences Method factor loading under the hypothesis that the particular RIASEC dimension under consideration was measured equivalently in these two domains. As a second example, tests of Model E involved constraining the Activities and Occupational Presences Method factor loadings to be equal to each other and also constraining the Self-rating of Abilities I and II Method factor loadings to be equal to each other. Tests of the remaining models proceeded similarly.

Results

As a first step in tests of ME/I, we conducted an omnibus test of the equality of covariance matrices across populations in which each Λ_g (the factor pattern matrix, where the *g* subscript indicates the *g*th group) was fixed to be a 30 × 30 identity matrix, each Θ_g (ordinarily, the diagonal matrix of unique variances) was fixed to be a null matrix, and Φ_g (the factor covariance matrix for one comparison subgroup) was constrained to equal $\Phi_{g'}$ (for the other comparison subgroup). This test was conducted between Mainland males versus Hong Kong males, Mainland females versus Hong Kong females, Mainland males versus Mainland females, and

Hong Kong males versus Hong Kong females. Results (see Table 1) indicated that this restricted model provided a good fit to the data for all four comparisons. Although all chi-square statistics were statistically significant, all of the remaining goodness-of-fit indices generally met or exceeded values that indicate good fit (Hu & Bentler, 1998, 1999). As such, results of these omnibus tests of ME/I demonstrated ME/I across all subgroups. Consequently, further tests of specific aspects of ME/I were neither needed nor warranted, indicating that the data could be pooled, and that single-group MTMM (see Appendix A) analyses could proceed (Cole & Maxewell, 1985; Vandenberg & Lance, 2000).

Results from tests of the CFA models tested based on the pooled MTMM matrix (n = 801) are summarized in Table 2. All chi-square statistics associated with the models were statistically significant ($p<.01$) and none of the models tested fit the data well according to current standards (Hu & Bentler, 1998, 1999) with CFIs ranging from .24 to .89, TLIs from .18 to .86, RMSEAs from .075 to .22, and SRMSRs from .075 to .17. However, given that these models constitute the universe of plausible models, we judged that Model 3C (CFI=.89, TLI=.86, RMSEA=.075, SRMSR=.13) best fit the data. Furthermore, when comparing Model 3C to the other models, all incremental chi-square statistics were statistically and practically significant.

We also conducted comparisons among selected models reported in Table 2 as tests of several aspects of construct validity of the Chinese SDS. For example, according to Widaman (1992), an omnibus test of convergent validity is provided by comparing Models 3C (which specifies t correlated Trait factors and m correlated Method factors) and 1C (which specifies *no* Trait factors and m correlated Method factors). This comparison is a test of convergent validity in that it constitutes a test of the difference in fit between a model that specifies Trait *and* Method factors (Model 3C) and an alternative model that specifies only Method factors (Model

1C). The comparison between these two models ($\Delta\chi^2(45) = 6924.55$, $p<.01$) indicated that the Chinese SDS demonstrated strong convergent validity in the assessment of the RIASEC traits. Discriminant validity was assessed by comparing Models 3C (which specifies *t* correlated Trait and *m* correlated Method factors) and 2C (which specifies *m* correlated Method factors but only one general Trait factor). This comparison comprises an omnibus test of discriminant validity as it assesses the difference in fit between one model that specifies *t* discriminable (though possibly correlated) Trait factors (Model 3C) and an alternative model that specifies only one undifferentiated Trait factor (Model 2C). The comparison between these models also strongly supported discriminant validity for the Chinese SDS ($\Delta\chi^2(15) = 3215.85$, $p<.01$), indicating that, although some were correlated, the RIASEC traits as measured by the Chinese SDS were empirically distinct. The presence of method effects was tested by comparing Models 3C (which specifies *t* correlated Trait factors and *m* correlated Method factors) and 3A (which specifies *t* correlated Trait factors but *no* Method factors). This comparison was also significant ($\Delta\chi^2(40) = 2277.78$, $p<.01$), indicating that a significant proportion of variance in SDS ratings wass accounted for by differences in the five content domains' measurement properties. Finally, the discriminability of methods was tested by comparing Models 3C (which specifies *t* correlated Trait and *m* distinct but possibly correlated Method factors) and 3B (which specifies *t* correlated Trait factors but only one general, undifferentiated Method factor). This comparison indicated that the five different methods in the Chinese SDS were indeed distinct from one another ($\Delta\chi^2(10) =800.48$, $p<.01$).

Results for model 3C (representing the best fitting MTMM CFA model) in the upper portion of Table 3 show Trait and Method factor loadings and unique variances for each trait-method combination. All the factor loadings were significantly larger than zero, except for the

Conventional interest as measured by the Self-rating on Abilities I which had a negative loading on the corresponding Conventional Trait factor. With few exceptions, loadings on Trait factors generally were higher than those on Method factors. Most of the correlations between the Trait factors (shown in the bottom portion of Table 3) were small to moderate (within $\pm$.50 range), with the exceptions that the correlations were higher (larger than .70) between Realistic and Investigative factors and between Social and Enterprising factors, and this is consistent with Holland's hexagonal model and previous research (e.g., Holland, 1985b; Lowman, Williams & Leeman, 1985; Tuck & Keeling, 1980). We also conducted supplementary analyses to directly compare the proportions of variance accounted for by traits and methods. Specifically, we squared the factor loadings in order to index the absolute effect size and to avoid the problem of having the negative factor loadings cancel out other positive loadings. We then converted the squared factor loadings to *z* scores, averaged the *z* scores, and then back-transformed the *z*-scores to the estimated mean squared factor loadings. Results (Table 4) suggested that variance accounted for by traits (mean trait $\lambda^2 = .51$) was significantly larger than the variance accounted for by methods (mean method $\lambda^2 = .26$; paired-sample $t\,(29) = 4.12$, $p < .01$), indicating that almost twice as much variance in Chinese SDS scales scores was attributable to the trait being assessed (i.e., RIASEC) as compared to the method employed to assess it.

Finally, the seven nested models based on theory as well as previous research findings were tested for each of the six vocational interests to determine whether they were measured differently by the five domains. The results are shown in Tables 5 through 10. All the chi-square statistics were significant ($p<.01$). None of the models fit the data well by current standards with CFIs ranging from .87 to .89, TLIs from .84 to .86, RMSEAs from .075 to .081, and SRMSRs from .067 to .13. $\Delta\chi^2$ tests indicated that for Realistic and Conventional interests (adjacent types), the best fitting model was Model B, in which Activities and Occupational Preferences domains provided equivalent measurement. For Investigative and Artistic interests (adjacent types), Model A was the best fitting model, indicating that these interests were measured differently by all the five domains. For Social and Enterprising interests (adjacent types), Model E best fit the data, indicating that these interests were measured equivalently by the Activities and Occupational Preferences domains, and also by Self-ratings of Abilities I and II domains. Note however, even where there were statistically significant differences in many of the model fit, practical changes in model fit (in terms of changes in alternative model GFIs) were often small, indicating that in some cases measurement was practically, but not statistically equivalent across many of the domains.

Discussion

The current study was designed to (a) examine the ME/I of the Chinese SDS across gender and geographic regions; (b) assess the construct validity of the Chinese SDS using Widaman's (1985, 1992) MTMM framework; and (c) determine whether like-named traits are measured differently by some subset of the five Chinese SDS subtests.

Results supported the ME/I of the Chinese SDS across males and females as well as across populations in Mainland China and Hong Kong. Males and females from different geographic locations in China interpreted the Chinese SDS in a conceptually similar manner. This suggests that there is no need to construct different forms of the Chinese SDS for different populations in China, that is, gender and cultural differences in terms of vocational interests in China can be studied with confidence that the assumption of invariant measurement operations across populations being compared is met.

Results also showed that the MTMM model was applicable to SDS data. Among the CFA models tested, the complete model (Model 3C) best described the data. This is consistent with Dumenci's (1995) findings for the English SDS (1985 edition). Results indicate that subscale scores reflect both the vocational interests being measured and the measurement domain subtests. Although these latter method factor loadings are significantly larger than zero, trait factors account for almost twice as much variance as method factors. Therefore, the Chinese SDS subscale scores are mainly a reflection of the vocational interests intended to be measured and not the measurement method (Oosterveld, 1994). The Chinese SDS also possesses good convergent and discriminant validity as a measure of the six interest types. High correlations between Realistic and Investigative interests as well as between Social and Enterprising interests are consistent with the theoretical assertion that they are adjacent types of interests and therefore are very similar to each other (Holland, 1973, 1985a, 1997). Also, the Activities and Occupational Preferences domains are highly correlated with each other (r =.87, $p<.01$). This is consistent with Tuck and Keeling's (1980) conclusion that these two domains constitute the affective element of the SDS. While Model 3C provided the best fit to the data of the models we tested, we must note that none of the models tested provided an adequate fit by most contemporary standards (Hu & Bentler, 1998, 1999). This may be because there are other models that lie outside Widaman's (1985, 1992) taxonomy that we did not test that might provide a better fit to the type of data we reported here and we suggest that future research might address this possibility. However, we also note that (a) the models that we tested here were very sparsely parameterized, that is, they were very parsimonious models, (b) it is common for very parsimonious models to provide a practically good, but statistically imperfect, fit to the data being studied, and (c) the range of model fit indices here is consistent with previous CFA modeling of RIASEC matrices (e.g., Dumenci, 1995).

The current study also examined a series of models based on theory and empirical findings. Theoretically, like-named vocational interest should be measured equivalently by different subtests in the SDS. However, the findings suggested that (a) four out of the six interest types (i.e., Realistic, Social, Enterprising, and Conventional) were measured equivalently by Activities and Occupational Preferences subtests; (b) Social and Enterprising interests were measured equivalently by Self-ratings on Abilities I and Self-ratings on Abilities II subtests; and (c) Investigative and Artistic interests were measured differently by each subtest in the SDS. Although many of the models were nearly equivalent in a practical sense, these results provide additional evidence that the five subtest profiles contain somewhat different information (Dumenci, 1995; Oosterveld, 1994). In this context, Yang et al (2005) examined circular order hypothesis based on RIASEC scores of the Chinese SDS. They found that the circular order structure was more likely to be applicable in Chinese populations when vocational interests were measured by Activities and Occupational Preferences subtests. Taking these results together, it seems that the Activities and Occupational Preference subtests demonstrate somewhat stronger construct validity in Chinese populations. The implication is that the users of the Chinese SDS should be cautious when interpreting their RIASEC scores and using such information to make vocational decisions. The lack of measurement invariance of some like-named interests across domains might relate to the issue that the conceptually non-equivalent translated test items may not tap the same information as they originally intend (Marsella, Dubanoski, Hamada, & Morse, 2000). The SDS was originally developed in the US context, and some of the items might not be culturally relevant for Chinese people (Leung & Hou, 2001), such as items which pertain to repairing automobiles, changing engine oil and tires, filing tax forms, etc. As there is no tax return in China and it is not very common for people to own automobiles, these test items are not as appropriate for the Chinese context. Also, some of the occupations in the SDS (e.g., anthropologist, substance abuse counselor) are so rare in China that people might not be familiar with them. More careful adaptation of the test items of the SDS in the Chinese context is warranted.

In sum, the Chinese SDS demonstrated good construct validity as well as ME/I across gender and geographic locations in China. This self-administered, self-scored, and self-interpreted instrument appears to possess sound psychometric properties and can be helpful to advance vocational research and career counseling in China. However, the like-named interests are not measured equivalently across domains. This might be due to the inappropriateness of some of the test items for the Chinese context. Future research should examine the Chinese SDS more closely and culturally inappropriate items should be adapted to the local context.

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Table 1

Omnibus Test of Equality of Covariance Matrices Across Subpopulations

Comparison	χ^2	df	TLI	CFI	RMSEA	SRMSR
Mainland males vs. Hong Kong males	671.23	465	.96	.98	.037	.074
Mainland females vs. Hong Kong females	682.09	465	.97	.98	.039	.040
Mainland males vs. Mainland females	629.55	465	.96	.98	.037	.087
Hong Kong males vs. Hong Kong females	718.17	465	.96	.98	.042	.057

Note. TLI = Tucker-Lewis Index; CFI = comparative fit index; RMSEA = root mean squared error of approximation; SRMSR = standardized root mean squared residual

Table 2

Fit indices of Widaman's (1985) 16 hierarchical models

Model	χ^2	Df	TLI	CFI	RMSEA	SRMSR
Null	13684.66 (p<.01)	435	--	--	--	--
1B	9490.82 (p<.01)	405	.26	.31	.21	.17
1B'	10504.90 (p<.01)	405	.18	.24	.22	.24
1C	8788.62 (p<.01)	395	.30	.37	.22	.17
2A	9490.82 (p<.01)	405	.26	.31	.21	.17
2'A	5355.68 (p<.01)	405	.60	.63	.14	.20
2B	13684.66 (p<.01)	375	--	--	--	--
2'B	3894.22 (p<.01)	375	.69	.73	.12	.14
2B'	7104.12 (p<.01)	375	.41	.49	.17	.20
2'B'	3513.18 (p<.01)	375	.73	.76	.11	.19
2C	5079.92 (p<.01)	365	.58	.64	.15	.089
2'C	2542.15 (p<.01)	365	.80	.84	.09	.12
3A	4141.85 (p<.01)	390	.68	.72	.13	.093
3B	2664.55 (p<.01)	360	.79	.83	.095	.075
3B'	2515.18 (p<.01)	360	.80	.84	.091	.086
3C	1864.07 (p<.01)	350	.86	.89	.075	.13

Note. TLI = Tucker-Lewis Index; CFI = comparative fit index; RMSEA = root mean squared error of approximation; SRMSR = standardized root mean squared residual. The Null model and Model 2B did not return proper solutions.

Table 3

Factor pattern matrix and factor correlations for Model 3C

	R	I	A	S	E	C	Act	Com	Occ	Sr1	Sr2	Unique Variance
RAct	.89	.	.	.	.	.	.43	.	.	.	.	.27
IAct	.	.90	.	.	.	.	.43	.	.	.	.	.26
AAct	.	.	.75	.	.	.	.53	.	.	.	.	.23
SAct	.	.	.	.56	.	.	.65	.	.	.	.	.40
EAct	.	.	.	.	.74	.	.40	.	.	.	.	.43
CAct	.	.	.	.	.	.75	.51	.	.	.	.	.32
RCom	.84	.	.	.	.	.	.	.29	.	.	.	.35
ICom	.	.91	.	.	.	.	.	.31	.	.	.	.24
ACom	.	.	.69	.	.	.	.	.50	.	.	.	.32
SCom	.	.	.	.75	.	.	.	.55	.	.	.	.23
ECom	.	.	.	.	.77	.	.	.49	.	.	.	.24
CCom	.	.	.	.	.	.40	.	.60	.	.	.	.53
ROcc	.85	.	.	.	.	.	.	.	.40	.	.	.33
IOcc	.	.69	.	.	.	.	.	.	.67	.	.	.39
AOcc	.	.	.66	.	.	.	.	.	.56	.	.	.31
SOcc	.	.	.	.58	.	.	.	.	.70	.	.	.33
EOcc	.	.	.	.	.69	.	.	.	.56	.	.	.39
COcc	.	.	.	.	.	.77	.	.	.42	.	.	.34
RSr1	.82	.	.	.	.	.	.	.	.	.09	.	.36
ISr1	.	.83	.	.	.	.	.	.	.	.12	.	.34
ASr1	.	.	.71	.	.	.	.	.	.	.25	.	.44
SSr1	.	.	.	.54	.	.	.	.	.	.43	.	.56
ESr1	.	.	.	.	.62	.	.	.	.	.31	.	.54
CSr1	.	.	.	.	.	-.11*	.	.	.	.90	.	.17
RSr2	.66	.	.	.	.	.	.	.	.	.	.47	.48
ISr2	.	.74	.	.	.	.	.	.	.	.	.31	.44
ASr2	.	.	.62	.	.	.	.	.	.	.	.24	.58
SSr2	.	.	.	.49	.	.	.	.	.	.	.48	.54
ESr2	.	.	.	.	.61	.	.	.	.	.	.57	.31
CSr2	.	.	.	.		.13	.	.	.	.	.75	.42

	R	I	A	S	E	C	Act	Com	Occ	Sr1	Sr2
R	1.00	.	.	.	.	.	.	.	.	.	.
I	.74	1.00	.	.	.	.	.	.	.	.	.
A	.08*	-.01*	1.00	.	.	.	.	.	.	.	.
S	.26	.24	.32	1.00	.	.	.	.	.	.	.
E	.40	.33	.29	.71	1.00	.	.	.	.	.	.
C	.35	.41	-.13	.16	.42	1.00	.	.	.	.	.
Act	.	.	.	.	.	.	1.00	.	.	.	.
Com	.	.	.	.	.	.	.72	1.00	.	.	.
Occ	.	.	.	.	.	.	.87	.61	1.00	.	.
Sr1	.	.	.	.	.	.	.35	.63	.35	1.00	.
Sr2	.	.	.	.	.	.	.30	.59	.27	.76	1.00

Note. *N*=801; a point denotes a parameter whose value was restricted to zero on an a priori basis. Parameter estimates are rounded to two decimal points. All parameter estimates are statistically significant ($p<.05$) unless indicated otherwise by an asterisk. R=Realistic; I=Investigative; A=Artistic; S=Social; E=Enterprising; C=Conventional; Act=Activities; Com=Competencies; Occ=Occupational Preferences; Sr1=Self-rating on Abilities I; Sr2=Self-rating on Abilities II.

Table 4

Variance components analysis for traits and methods

	Traits			Methods	
	Mean *z* score	Mean *z* score back to λ^2		Mean *z* score	Mean *z* score back to λ^2
R	.83	.68	Act	.26	.25
I	.86	.70	Com	.23	.22
A	.53	.48	Occ	.33	.32
S	.37	.35	Sr1	.25	.24
E	.52	.48	Sr2	.26	.26
C	.30	.29			
Mean	.57	.51	Mean	.27	.26

Note. Estimates are rounded to two decimal points. R=Realistic; I=Investigative; A=Artistic; S=Social; E=Enterprising; C=Conventional; Act=Activities; Com=Competencies; Occ=Occupational Preferences; Sr1=Self-rating on Abilities I; Sr2=Self-rating on Abilities II

Table 5

Fit indices and model comparisons for the seven nested models for the Realistic interest

	df	χ^2	CFI	TLI	RMSEA	SRMSR
Model A	350	1864.07	0.89	0.86	0.075	0.13
Model B	351	1865.50	0.89	0.86	0.075	0.13
Model C	351	1881.15	0.88	0.86	0.075	0.13
Model D	352	1889.90	0.88	0.86	0.075	0.13
Model E	352	1882.72	0.88	0.86	0.075	0.13
Model F	353	1891.28	0.88	0.86	0.075	0.13
Model G	354	1903.70	0.88	0.86	0.075	0.13

	Δdf	$\Delta\chi^2$
Model B vs. Model A	1	1.43
Model C vs. Model A	1	17.08**
Model D vs. Model A	2	25.83**
Model E vs. Model A	2	18.65**
Model F vs. Model A	3	27.21**
Model G vs. Model A	4	39.63**

Note. TLI = Tucker-Lewis Index; CFI = comparative fit index; RMSEA = root mean squared error of approximation; SRMSR = standardized root mean squared residual

Table 6
Fit indices and model comparisons for the seven nested models for the Investigative interest

	df	χ^2	CFI	TLI	RMSEA	SRMSR
Model A	350	1864.07	0.89	0.86	0.075	0.13
Model B	351	1902.12	0.89	0.86	0.075	0.13
Model C	351	1870.60	0.88	0.86	0.075	0.13
Model D	352	1889.74	0.88	0.85	0.075	0.13
Model E	352	1909.36	0.88	0.85	0.075	0.13
Model F	353	1928.83	0.88	0.85	0.075	0.13
Model G	354	1929.09	0.88	0.85	0.075	0.13

	Δdf	$\Delta\chi^2$
Model B vs. Model A	1	38.05**
Model C vs. Model A	1	6.53**
Model D vs. Model A	2	25.67**
Model E vs. Model A	2	45.29**
Model F vs. Model A	3	64.76**
Model G vs. Model A	4	65.02**

Note. TLI = Tucker-Lewis Index; CFI = comparative fit index; RMSEA = root mean squared error of approximation; SRMSR = standardized root mean squared residual

Table 7

Fit indices and model comparisons for the seven nested models for the Artistic interest

	df	χ^2	CFI	TLI	RMSEA	SRMSR
Model A	350	1864.07	0.89	0.86	0.075	0.13
Model B	351	1874.13	0.89	0.86	0.075	0.13
Model C	351	1869.52	0.89	0.86	0.075	0.13
Model D	352	1870.21	0.89	0.86	0.075	0.13
Model E	352	1879.51	0.89	0.86	0.075	0.13
Model F	353	1880.13	0.88	0.86	0.075	0.13
Model G	354	1880.98	0.88	0.86	0.075	0.13

	Δdf	$\Delta\chi^2$
Model B vs. Model A	1	10.06**
Model C vs. Model A	1	5.45**
Model D vs. Model A	2	6.14**
Model E vs. Model A	2	15.44**
Model F vs. Model A	3	16.06**
Model G vs. Model A	4	16.91**

Note. TLI = Tucker-Lewis Index; CFI = comparative fit index; RMSEA = root mean squared error of approximation; SRMSR = standardized root mean squared residual

Table 8

Fit indices and model comparisons for the seven nested models for the Social interest

	df	χ^2	CFI	TLI	RMSEA	SRMSR
Model A	350	1864.07	0.89	0.86	0.075	0.13
Model B	351	1864.22	0.89	0.86	0.075	0.13
Model C	351	1865.21	0.89	0.86	0.075	0.13
Model D	352	1908.54	0.88	0.85	0.075	0.13
Model E	352	1865.33	0.89	0.86	0.075	0.13
Model F	353	1908.83	0.88	0.86	0.075	0.13
Model G	354	1909.81	0.88	0.86	0.075	0.13

	Δdf	$\Delta\chi^2$
Model B vs. Model A	1	0.15
Model C vs. Model A	1	1.14
Model D vs. Model A	2	44.47**
Model E vs. Model A	2	1.26
Model F vs. Model A	3	44.76**
Model G vs. Model A	4	45.74**
Model E vs. Model B	1	1.11
Model E vs. Model C	1	0.12

Note. TLI = Tucker-Lewis Index; CFI = comparative fit index; RMSEA = root mean squared error of approximation; SRMSR = standardized root mean squared residual

Table 9

Fit indices and model comparisons for the seven nested models for the Enterprising interest

	df	χ^2	CFI	TLI	RMSEA	SRMSR
Model A	350	1864.07	0.89	0.85	0.076	0.13
Model B	351	1865.99	0.89	0.86	0.075	0.13
Model C	351	1864.19	0.89	0.86	0.075	0.13
Model D	352	1893.61	0.88	0.86	0.076	0.12
Model E	352	1866.18	0.89	0.86	0.075	0.13
Model F	353	1895.15	0.88	0.86	0.076	0.12
Model G	354	1896.85	0.88	0.86	0.075	0.12

	Δdf	$\Delta\chi^2$
Model B vs. Model A	1	1.92
Model C vs. Model A	1	0.12
Model D vs. Model A	2	29.54**
Model E vs. Model A	2	2.11
Model F vs. Model A	3	31.08**
Model G vs. Model A	4	32.78**
Model E vs. Model B	1	0.19
Model E vs. Model C	1	1.99

Note. TLI = Tucker-Lewis Index; CFI = comparative fit index; RMSEA = root mean squared error of approximation; SRMSR = standardized root mean squared residual

Table 10

Fit indices and model comparisons for the seven nested models for the Conventional interest

	df	χ^2	CFI	TLI	RMSEA	SRMSR
Model A	350	1864.07	0.89	0.85	0.076	0.13
Model B	351	1864.29	0.89	0.86	0.075	0.13
Model C	351	1896.71	0.88	0.86	0.075	0.13
Model D	352	2021.30	0.87	0.84	0.079	0.077
Model E	352	1896.85	0.88	0.86	0.075	0.13
Model F	353	1988.64	0.88	0.85	0.077	0.12
Model G	354	2098.04	0.87	0.84	0.081	0.067

	Δdf	$\Delta\chi^2$
Model B vs. Model A	1	0.22
Model C vs. Model A	1	32.64**
Model D vs. Model A	2	157.23**
Model E vs. Model A	2	32.78**
Model F vs. Model A	3	124.57**
Model G vs. Model A	4	233.97**

Note. TLI = Tucker-Lewis Index; CFI = comparative fit index; RMSEA = root mean squared error of approximation; SRMSR = standardized root mean squared residual

Appendix A

Appendix A: Multitrait-Multimethod Matrix of the Self-Directed Search for the pooled sample

	M	SD	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	26	27	28	29	30
RAct	4.70	3.36	1.00																													
IAct	4.99	3.26	.50	1.00																												
AAct	5.54	3.24	.12	-.02	1.00																											
SAct	5.61	2.43	.15	.15	.34	1.00																										
EAct	5.81	3.17	.25	.19	.15	.33	1.00																									
CAct	3.78	2.90	.20	.26	.05	.22	.34	1.00																								
RCom	3.40	3.06	.69	.41	.03	.10	.24	.16	1.00																							
ICom	6.10	3.85	.45	.71	-.11	.05	.24	.20	.44	1.00																						
ACom	4.32	2.74	.09	-.01	.64	.32	.21	.07	.13	.02	1.00																					
SCom	6.27	3.21	.16	.08	.28	.52	.46	.19	.16	.13	.43	1.00																				
ECom	5.26	3.38	.25	.18	.19	.32	.59	.28	.28	.25	.40	.68	1.00																			
CCom	7.01	2.31	.08	.08	.05	.11	.23	.45	.10	.13	.17	.25	.27	1.00																		
ROcc	3.06	3.40	.71	.48	.00	.09	.16	.15	.60	.42	.02	.05	.13	.06	1.00																	
IOcc	5.16	4.00	.38	.63	.17	.32	.20	.22	.32	.48	.16	.15	.19	.15	.48	1.00																
AOcc	5.14	4.10	.02	-.08	.72	.30	.14	.07	-.04	-.15	.58	.26	.17	.09	-.02	.19	1.00															
SOcc	5.62	4.04	.10	.06	.30	.68	.35	.25	.08	.01	.33	.51	.35	.18	.11	.36	.38	1.00														
EOcc	4.32	3.66	.22	.05	.32	.30	.62	.35	.17	.08	.36	.44	.52	.26	.18	.21	.39	.47	1.00													
COcc	2.69	3.81	.19	.29	.00	.14	.30	.63	.17	.23	.01	.13	.19	.36	.30	.27	.07	.24	.39	1.00												
RSr1	3.03	1.79	.54	.39	-.12	-.03	.14	.05	.64	.47	-.01	.05	.19	.00	.53	.25	-.15	-.05	.06	.13	1.00											
ISr1	3.92	1.94	.42	.55	-.15	-.05	.15	.09	.46	.68	-.03	.02	.19	.00	.41	.34	-.18	-.07	.01	.13	.68	1.00										
ASr1	3.88	1.57	.04	-.01	.52	.10	.09	-.06	.08	.10	.52	.19	.19	.03	-.03	.06	.46	.12	.20	-.02	.07	.08	1.00									
SSr1	4.53	1.52	.04	.17	.10	.29	.25	.17	.12	.23	.27	.45	.39	.15	.02	.14	.08	.31	.21	.12	.15	.25	.29	1.00								
ESr1	3.45	1.54	.12	.02	.14	.17	.41	.14	.15	.10	.25	.43	.53	.16	.03	.07	.12	.23	.48	.16	.17	.12	.24	.37	1.00							
CSr1	4.87	1.41	-.18	-.11	.17	.17	.08	.15	-.15	-.05	.27	.22	.20	.41	-.22	.04	.21	.21	.16	.03	-.21	-.12	.21	.31	.22	1.00						
RSr2	4.52	1.46	.42	.33	-.06	-.01	.17	.18	.44	.42	.04	.13	.23	.19	.38	.22	-.07	.02	.12	.18	.52	.53	.10	.25	.23	.13	1.00					
ISr2	4.33	1.71	.25	.55	-.21	-.07	.15	.19	.28	.61	-.09	.05	.17	.16	.29	.24	-.19	-.09	.01	.26	.40	.58	.01	.29	.13	.01	.47	1.00				
ASr2	3.48	1.61	-.03	-.02	.39	.02	.02	-.01	.00	-.01	.49	.15	.17	.06	-.05	-.01	.33	.08	.14	.01	.04	.05	.54	.22	.22	.16	.12	.10	1.00			
SSr2	5/39	1.27	.07	.03	.13	.29	.22	.08	.09	.08	.23	.51	.36	.15	-.01	.10	.14	.31	.25	.06	.02	.08	.19	.36	.28	.27	.23	.14	.18	1.00		
ESr2	4.69	1.36	.13	.11	.09	.18	.47	.22	.17	.17	.24	.49	.64	.25	.08	.12	.06	.27	.40	.17	.11	.15	.18	.42	.47	.30	.31	.25	.18	.51	1.00	
CSr2	5.13	1.23	-.01	-.04	.05	.11	.23	.28	.00	.01	.12	.25	.28	.45	-.05	.04	.05	.16	.25	.13	-.07	-.02	.06	.23	.21	.50	.27	.14	.10	.34	.50	1.00

Notes. N=801. Estimates are rounded to two decimal points. R=Realistic; I=Investigative; A=Artistic; S=Social; E=Enterprising; C=Conventional; Act=Activities; Com=Competencies; Occ=Occupational Preferences; Sr1=Self-rating on Abilities I; Sr2=Self-rating on Abilities II