

Cross Cultural Factor Analytic Studies of a Multiple Intelligences Self-Assessment

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Abstract

The author describes cross cultural exploratory factor analyses of a self-assessment for the multiple intelligences (MI: Gardner, 1983, 1993). Adolescent and adult participants in 18 countries completed either the original English or one of six translated versions of the Multiple Intelligences Developmental Assessment Scales (MIDAS; Shearer, 2007). Strong concurrences in psychometrics, factor structure and item analysis among three large samples are described: North American (n=10,580); English speaking countries (9 countries, n=2,615) and foreign language translations (9 countries, n= 2,908). Minor deviations from theoretical expectations indicate the limited influence of cultural differences on the existence of the eight universal constructs described by MI theory.

Keywords: multiple intelligences, construct validity, factor analysis, cross cultural validity

Introduction

Since multiple intelligences theory was introduced by Howard Gardner in his influential and controversial book, *Frames of Mind*, (1983, 1993) psychologists and educators around the world have criticized the theory because there is no psychometrically valid test for the various intelligences. Educators require an assessment that will describe students' unique profiles for classroom use (Armstrong, 1994; Chen, et al, 1998; Stefanakis, 2002) while psychological and educational theorists question the theory's validity because it doesn't accord with the psychometric tradition and lacks large-scale empirical validation (Gottfriedson, 1998; Herrnstein & Murray, 1994; Sternberg, 1985; Waterhouse, 2006; Willingham, 2005).

Gardner's response to critics is that many empirical studies from a variety of disciplines (psychometric, anthropology, developmental psychology, neuroscience, etc.) are cited in *Frames* as the basis for his "subjective factor analysis" that resulted in the original seven and subsequently eight different intelligences, e.g., linguistic, logical-mathematical, spatial, kinesthetic, musical, interpersonal, intrapersonal (and later), naturalist (Gardner, 1999). However, data from such wide ranging sources that challenge a well-established paradigm are not convincing evidence to a field rooted in the psychometric tradition.

The development of a test for the multiple intelligences (MI) would seem to be the answer to satisfy both educators and researchers alike. The creation of such a test has been hampered, however, due to the complex definition of intelligence and the contextual / creative characteristics of each intelligence (see Appendix 1). Despite some limited success with a test for young children, Gardner and his colleagues have essentially abandoned efforts in test development expressing doubts that any MI test can be created that possesses ecological validity and reliability using existing testing paradigms (Gardner, 2004).

Gardner's meta-empirical/trans-disciplinary approach to MI theory building for nearly 30 years has appealed to large numbers of educators around the world (Chen, Moran & Gardner, 2009), but has failed to convince data-oriented, experimental research psychologists. Nearly one hundred years of data collection supporting the validity of the unitary construct of general intelligence (*g*) (and embraced by psychologists and the general public in the IQ score) cannot be undermined by what is referred to as "merely a literary theory" rather than a scientific verity by its critics (personal communication).

The need for a databased, empirically validated assessment for the multiple intelligences is obvious, if rational decisions are to be made regarding its inclusion or exclusion from classrooms, schools and the cannon of educational and psychological theory. The problem is two-fold. Is there statistical evidence that MI is a valid, scientific theory? And second, can an MI assessment be created that has validity and reliability so that it can be used for research as well as in the classroom for educational purposes?

The data analyses presented here extend a research and development program begun in 1987 that has explored both the efficacy and essential validity of a unique multiple intelligences assessment, *Multiple Intelligences Developmental Assessment Scales* (MIDAS; Shearer, 2007). This article compares two studies to large scale factor analytic investigations reported by Shearer (2010) that previously found robust support for the existence of the eight theoretical constructs as measured by the MIDAS scales for a North American population. This work also extends several international studies that have independently tested the psychometric validity of MIDAS translations in Korea (Kim, 1999), Chile (Pizarro, 2003); Egypt, (Koshaha, 2003); Taiwan (Shearer & Wu, 2008) and Malaysia (Yoong, 2001).

The goal of the two present studies is to investigate the validity of Gardner's trans-disciplinary "subjective factor analysis" that describes eight relatively autonomous constructs by using accepted statistical procedures of data analysis on multiple and diverse populations. Exploratory factor analysis is employed rather than confirmatory analysis for two reasons. First, we do not want to assume that translations of the questionnaire applied in a diverse array of cultures will reveal the same factor structure as was obtained in North America. Second, our goal is to replicate as nearly as possible the initial data analyses that were conducted on the original North American samples. Confirmatory analyses may be applied on new samples at a future date, if warranted.

Data analysis proceeds in four steps:

1. descriptive and reliability statistics
2. exploratory factor analysis
3. item - scale content analysis

After briefly describing the eight multiple intelligences and the development of the MIDAS and its psychometrics, a summary of the previous factor analytic study of a North American sample is presented. This is followed by a detailed description of the two present studies that explore the factor structure and validity of this scale for cross cultural samples.

MI theory postulates that the eight multiple intelligences are universal human cognitive abilities that are all essentially of equal value, but that they vary in importance depending upon the individual and the needs and values of particular cultural contexts. While Gardner provides detailed cross cultural evidence in support for the existence of different intelligences, it is vital to their acceptance that broad-based data rigorously test

their existence. His mostly anecdotal cross cultural evidence can be criticized as merely “cherry picking” behaviors that support his arguments without the benefit of large scale systematically collected data.

The Theory of Multiple Intelligences

Gardner uses a unique definition of intelligence and several specific criteria when he argues for the existence of eight distinct forms of intelligence. According to Gardner’s definition (1999) intelligence is, “a biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture” (p. 34). Candidate intelligences are then evaluated for how well they meet a range of criteria including, identifiable cerebral structures, distinct core cognitive components, evidence from psychometric studies, experimental psychological research, developmental pathways, etc. Another key criteria in his argument is evidence from non-European cultures. Most of the evidence that Gardner presents from other cultures is anecdotal rather than empirical.

In the minds of many people, MI is viewed as being “anti-IQ” but this is not true because IQ-related skills are integral components of the Linguistic and Logical-mathematical intelligences. However, MI expands beyond academic skills to include creative (poetry, novels) and practical abilities (technical manuals, explanations) associated with each of eight intelligences.

The Visual-spatial intelligence is likewise an essential part of many standard IQ-type tests but MI extends this set of abilities to include the creative arts and imagination. The same holds true for the Musical and Kinesthetic intelligences where there are obvious academic aspects to each (ballet and classical music) as well as creative (choreography, jazz and improvisation) and pragmatic applications (handcrafts and social music). The Naturalist intelligence is represented in the standard academic curriculum in science but it also includes understanding of living things and pattern recognition.

The Intrapersonal and Interpersonal intelligences have been the subject of a great deal of research in recent years in terms of metacognition and social-emotional abilities, respectively. The core features of these two intelligences are the understanding of oneself (Intra) and the understanding of other people (Inter). As common sense would indicate, along with Linguistic intelligence these two intelligences are strongly associated with success in school.

The intelligences are neither monolithic nor simplistic, but rather each is comprised of a set of specific skills that are all related to the core cognitive components. For example, Musical intelligence is expressed in skills related to musical composition, vocal ability, instrumental skills and the understanding of music. Detailed definitions of each intelligence are presented in Appendix 1.

Development and Validation of the Multiple Intelligences Developmental Assessment Scales

The *Multiple Intelligences Developmental Assessment Scales* (MIDAS) is a self completed questionnaire that can be administered and interpreted by psychologists, counselors and teachers. The MIDAS inquires about developed skill, levels of

participation, and enthusiasm for a wide variety of activities that are naturally encountered as a part of daily life. The MIDAS was initially developed in 1987 as a structured interview format to assess the multiple intelligences for adolescents and adults undergoing cognitive rehabilitation (Way and Shearer, 1990). Given the complex, contextual nature of each intelligence a structured interview of key behavioral indices was chosen as the best method of obtaining a “rich and descriptive understanding” of the person’s intellectual strengths and limitations in a time efficient manner.

Development of the MIDAS. The MIDAS was developed over a period of six years using a combination of rational and empirical methods of test construction with MI theory as a basis to guide interpretation of empirical results. Initially, a large number of items ($n = 125$) were generated through a careful reading of the behavioral characteristics of each intelligence as articulated in *Frames of Mind* (Gardner, 1983 / 1993). Subject area experts (including Howard Gardner) reviewed these questions. Items were then field tested via in-depth interviews, whereby interviewees provided feedback on question wording and content clarity. A series of quantitative studies were then conducted to examine inter-informant and test-retest reliability, item response patterns, factor structure, and inter-item correlations (Way & Shearer, 1990; Shearer, 1992; Shearer & Jones, 1994).

To increase the educational utility of the assessment, within scale factor analyses were conducted to create and verify domain-specific subscales pertaining to each of the main intellectual scales (e.g., Instrumental and Vocal for Musical) (Shearer, 2007). These subscales consist of a few items each and are intended as “qualitative indicators” to be verified by the respondent rather than as precise psychometric measures. Thus, they are not a focus of this factor analytic investigation of the eight main scales, but subscales are useful for qualitative interpretation of the results.

Each MIDAS item has six response choices (e.g., “*Are you good at finding your way around new buildings or city streets?*” *Not at all, Fairly Good, Good, Very Good, Excellent, I don’t know or Does not apply*). Response anchors are uniquely written to match each question’s specific content. A *Does not apply* or *I don’t know* option is provided for every question so that the respondent is not forced to guess or answer beyond his or her actual level of knowledge. The wording of each response choice was carefully calibrated during scale development informed by the response patterns of a representative group of respondents. This careful crafting of response choices resulted in a mixed pattern of responding to questions (some high, some low and some moderate) so that the mean score for all scales is consistently in the moderate range.

Percentage scores for each scale are calculated from the total number of responses using a scoring matrix derived from initial factor analytic studies. A majority of items score only on a primary designated scale and a few questions representing complex behaviors score on two scales. The selection of co-scoring items was made whenever there was an agreement between MI theoretical expectations and empirical data analysis. For example, the question regarding skill at playing chess scores on both the spatial and the logical-mathematical scales.

Psychometric properties. Numerous studies have examined the reliability and validity of the MIDAS. Early investigations are summarized in the *MIDAS Professional Manual* (Shearer, 2007). The MIDAS has been favorably evaluated (Buros, 1999),

suggesting support for use of the assessment within educational contexts along with suggestions for further scale research and development.

Reliability. As reported in the *Professional Manual*, across several diverse samples, mean internal consistencies of each MIDAS scale fall in the high-moderate to high range, with alpha coefficients ranging from .78 to .89 (median = .86). Wiswell, Hardy and Reio (2001) found reliability coefficients ranged from .85 - .90. Similar alpha coefficients were obtained for all scales in several international studies of MIDAS translations (Malaysian, Yoong, 2001; Spanish, Pizarro, 2003; Korean, Kim, 1999)

The test-retest reliability of the MIDAS was assessed in two separate investigations, revealing one-month stability coefficients ranging from .76 to .92 (mean = .84) and two-month stability coefficients ranging from .69 to .86 (mean = .81) across the various intelligence scales (Shearer, 2007).

Validity. The validity of the MIDAS has been examined via a series of investigations evaluating its concurrent, predictive and construct validity. The results of a concurrent and predictive validity study concluded that "accumulated evidence supports its validity as a tool to gather useful and meaningful data regarding an individual's profile in seven areas of everyday intellectual functioning" (Shearer & Jones, 1994; Shearer, 2006). This study found that a majority of the scales correlated appropriately with tests of performance in the expected skills and abilities. For example, when the linguistic and logical-mathematical scale scores were combined at .59 correlation with a test of estimated IQ was observed. The linguistic scale correlates a .56 with a test of verbal skill and the logical-mathematical scale correlates at .55 with a math test. These are the highest correlations from among all of the MIDAS-test correlation matrix.

Several research studies have investigated the relationship of the MIDAS to various criterion measures. An appropriate pattern of correspondence among MIDAS mean scale scores and matched college majors and adult occupational groups has been observed in several studies. (Shearer and Luzzo, 2009; Shearer, 2007)

The results of these studies indicated that the scales were able to differentiate among people with demonstrated levels of skill in each of the theoretical constructs. For example, Writers score most highly on the linguistic scale (72%) while Skilled Tradespersons scored lowest (43%). Conversely, on the spatial scale Artists scored highest at 68% while Writers scored lowest at 42%. Psychologists scored highest on the interpersonal scale (68%) and Engineers scored lowest (45%). These differences make logical sense since scores above 60% are considered to be in the high range and scores below 40% are in the low ability range. These differences are also significantly different as tested by ANOVA.

The construct validity of the MI assessment was initially investigated using a small, homogenous sample of 349 adults and college students. Way and Shearer (1990) found that an eight-factor principal component solution accounted for 46% of the variance. Wiswell, Hardy and Reio (2001) concluded that their factor analytic studies of 1409 cases confirmed five of the eight scales were unique constructs, but that three of the other scales were not as clearly defined (spatial, kinesthetic and intrapersonal). Further validation studies were recommended. Yoong's (2001) factor analytic studies of a MIDAS Bahasa Malaysian translation (MIDAS-BM) found a seven factor principal components solution

accounted for 65% of the variance. Using varimax rotation the kinesthetic items did not cluster on any one factor. Pizarro, et al (2003) also confirmed the presence of seven factors using a Spanish translation with 429 high school students employing a principal components extraction followed by varimax rotation. Items expected to comprise the Intrapersonal factor instead loaded primarily on the Interpersonal factor.

These mixed results indicate the need for more a more extensive and systematic examination of the MIDAS scales' factor structure across cultures. If the factor structure holds up regardless of language translation and large scale data collected in extremely diverse cultures then this will provide systematic evidence in support of the theory of multiple intelligences.

Large scale exploratory and confirmatory factor analyses for a North American sample. Building on previous small scale studies exploratory and confirmatory factor analyses were conducted on a large (N= 10, 958) and diverse North American sample. The sample included participants from 12 states and from multiple regions of the United States as well as two Canadian providences. There were 5,558 females and 5,400 males (Shearer, 2010).

Item Statistics and Scale Reliabilities

The mean item response values (scored 1 - 5) for the 119 questions ranged from a low of 2.1 and a high of 3.9 with a median of 3.0. The standard deviation for item responses ranged from 1.0 to 1.5. The response patterns for each item were carefully reviewed for each scale. These values indicated that respondents used a full range of options when responding to the questions. Some questions were responded to highly while others had an evenly distributed pattern of responding. Overall, there was satisfactory mix of high, low and moderate response patterns.

The mean scale scores for the eight proposed scales are presented in Table 1. Most mean scores cluster around 50% except for the highest interpersonal scale (56%) and the lowest is Naturalist at 44%. Cronbach alpha reliabilities for the eight proposed scales ranged from .78 to .90 with median of .88 (see Table 2).

Table 1
Mean Scale Scores for Three Samples

Scale	North American		Study 1: English		Study 2: Translated	
	Mean	SD	Mean	SD	Mean	SD
Musical	48.61	20.47	45.91	19.06	45.85	17.28
Kinesthetic	48.79	17.83	45.98	17.12	44.61	16.76
Math-Logic	48.95	16.49	49.60	16.92	49.22	15.24
Spatial	50.88	17.43	47.96	17.63	46.53	15.85
Linguistic	50.26	17.84	49.06	16.95	50.57	16.01
Interpersonal	56.13	16.72	54.59	16.11	58.58	14.96
Intrapersonal	52.08	14.25	52.78	13.91	55.01	13.24
Naturalist	43.98	19.34	42.40	18.55	44.65	18.08

Groups: North American $n=10,958$; English $n=2,615$; Translated $n=2,908$.

Scale scores range from 0 - 100%

Table 2
Internal Item Reliabilities in 3 Studies

Scale	Studies		
	N.A.	#1	#2
Musical	.87	.88	.86
Kinesthetic	.79	.80	.80
Logical Math	.88	.89	.88
Spatial	.87	.87	.84
Linguistic	.90	.90	.90
Interpersonal	.89	.86	.87
Intrapersonal	.87	.86	.86
Naturalist	.90	.90	.89
	Grand mean	.87	

Note. All r Alpha Cronbach

Samples:

Study NA: North American sample (n=10,958), reported in Shearer, 2010.

Study #1: English language countries (n=2,615)

Study #2: Translated versions (n=2908)

Initially, various exploratory analyses were performed using the whole sample (N=10,958) and then a 50% random selection of the data was subjected to exploratory analysis. Confirmatory analyses then used a different random sample of 1800 cases.

Exploratory factor analysis. A principal component factor analysis was initially applied to 117 items (two non-scored items removed). To determine the appropriate number of factors guidelines described by Stevens (1996) were followed, including: a criteria of eigenvalues greater than one; scree plot examination, and practical interpretability; number of items and sample size and amount of total variance accounted for by factors. Seventeen factors were initially identified with eigenvalues greater than one that accounted for 56% of the variance using orthogonal varimax rotation.

The descending pattern of eigenvalues for the factors suggested simple factor solutions ranging from seven to eleven. This initial structure of seventeen factors was deemed to be meaningful because the first eight of the factors matched with the theoretically expected eight constructs and accounted for 36% of the variance. The next five factors (accounting for an additional 14% of variance) are near exact matches with five subscales within five different proposed main scales. The remaining four factors (accounting for 6% of variance) consist of only one item each and are not interpretable. In light of these data and the pattern of eigenvalues, a 9-factor solution was specified in the next round of analyses which accounted for 46% of the total variance.

The percentage of the variance accounted for by each of the factors in order was 7.1%, 7.0%, 5.8%, 5.4%, 5.2%, 4.6%, 4.4%, 3.7%, 2.8%. The factor content for these 9 factors is nearly identical with the theoretical framework expected for the MI scales. The

factor names closely parallel the scale structure of the MIDAS except for factors 6 and 7, which split the items on the predicted spatial scale into theoretically meaningful clusters.

Stevens (p. 394, 1996) recommends that item factor loadings of .40 or greater for at least 10 items for a sample size of at least 150 are required for reliable factor determination. Components with at least four items with loadings above .60 are reliable, regardless of sample size. Eight of the nine identified factors in this study meet these guidelines while the ninth factor is somewhat lacking.

Confirmatory Factor Analysis. A maximum-likelihood confirmatory factor analysis was applied to determine whether the 9-factor solution is acceptable using the computer program Amos v.4.0 (Arbuckle, 1999). The chi-square statistic was statistically significant, $\chi^2=30628.865$, $df=4655$, $p\leq .001$, indicating that the hypothesized model was reasonable and fit with the data, but this is not unexpected given the large sample size. The nine-factor model was also supported by the fact that (a) the goodness-of-fit index (GFI) and its value adjusted for the population (AGFI) were greater than .90 (see, e.g., Stevens, 1996, p. 399), and (b) the root mean square error of approximation (RMSEA) was .055 which is smaller than the recommended .06 (see, e.g., Arbuckle, 1997, p. 559). Other confirmatory statistics are as follows: Delta1 NFI = .933; RHO1 RFI = .930; Delta2 IFI = .943; RHO2 TLI = .940; and CFI = .943.

To further test the robustness of the 9-factor solution a series of multi-sample exploratory factor analyses were also conducted for three different age groups (teens, college students and adults). The resulting maximum likelihood solutions for each age group were virtually identical, thus lending further support for the adequacy of the 9-factor structure.

Although the MIDAS appears to be a reliable and valid measure of the multiple intelligences for North American populations, the following two studies sought to extend our knowledge about the cross cultural validity of scales' ability to assess the eight constructs.

Study 1

This study examined the psychometric properties and factor structure of the MIDAS using samples from nine different English speaking countries. Empirical support for the eight-factor (or nine factor) model was expected, but some variations were anticipated given the diversity of the various samples.

Methods

Participants. Participants came from nine different English speaking countries for a total of 2,615. There were 1,008 females (39%) and 1,472 males (56%) and 135 missing information. There were 1,473 teenagers, 847 university students and 295 adults. Exact ages were not recorded.

Table 3
Gender and Age Levels of Participants from 9 English Speaking Samples

Country	Sex		Age			Total
	Female	Male	Teens	Adult	University	
Hong Kong	110	87	28	0	171	199
Taiwan	155	47	0	0	203	203
Singapore	39	830	827	58	0	885
UK	113	123	189	73	0	262
Ireland	161	265	277	0	167	444
Australia	102	1	0	0	103	103
Canada	78	76	0	0	203	203
Philippines	151	1	152	0	0	152
India	99	42	0	164	0	164
Total	1008	1472	1473	295	847	2615

Teenage groups included the following grade levels: 167 7th, 622 9th, 99 10th, 86 11th and 225 12th. University students group included the following grade levels: 97 first year; 11 second year; 79 third year; and 176 fourth year. The university group also included 203 physics majors. The adult group included 198 nurses, 27 high school graduates, 42 with a university degree, 58 with a master degree, 3 graduates from a junior college and 2 with doctoral degrees.

Procedure. Participants in this study were adults and teenagers who completed the MIDAS assessment over a period of 15 years. Administrators were teachers, counselors and researchers who included MIDAS as part of either their research or educational programs. Administrators were required to become familiar with standard MIDAS administration procedures. All completed protocols were returned to the publisher for standard scoring and creation of a database. The names and identities of participants were removed from records prior to being included in the database to ensure anonymity. All participants completed the original MIDAS English questionnaire except for the Singaporean groups who completed an adapted English version that was somewhat modified to meet the needs of their particular culture.

Results

Psychometric properties of MIDAS – English language version: combined samples. Cronbach's alpha coefficient reliabilities reported in Table 2 range from a low of .80 (Kinesthetic) to a high of .90 (Naturalist and Linguistic). The mean scale scores for the eight scales range from 42% (Naturalist) to a high of 54% (Interpersonal) with a median of 49% (see Table 1). The mean item response values (scored 1 – 5) for the 119 questions ranged from a low of 2.09 to a high of 3.68 with a median of 3.0. The standard deviation for item responses ranged from .90 to 2.0 indicating that a full range of response choices were utilized.

Factor analysis of English language samples combined. Factor analytic studies of the data were then conducted following standard guidelines (Gorsuch, 1983; Nunnally, 1994) to determine if the questions were assessing the eight distinct constructs as hypothesized. The steps employed during the original analysis of the North American sample were followed to determine congruency.

A principal components orthogonal analysis was initially applied to 117 items (two non-scored items removed) followed by varimax rotation. Twenty factors were identified with eigenvalues greater than one that accounted for 56% of the variance. The KMO test of sampling adequacy was .956. The scree plot and the descending pattern of eigenvalues suggested simple factor solutions ranging from four to ten with a pronounced break at eight factors. The first 10 factors account for 45% of the variance and included all eight of the hypothetical factors with two scales splitting between two factors (Linguistic and Naturalist). The next four factors (accounting for an additional 5% of variance) include items that are near exact matches with four subscales within four different proposed main scales (Musical, Spatial, Kinesthetic, Linguistic).

When a 9 factor solution is specified, as was used with the North American data, the proposed Interpersonal and Intrapersonal constructs merge into one factor while the Naturalist and Spatial scales split into two factors each.

In light of these data, a 10 factor principal components analysis with Promax (Kappa 4) rotation was specified. This analysis resulted in a simple structure accounting for 45% of the variance with a pattern of item correlations that match the eight proposed scales except that Spatial and Naturalist scales split into two factors each. The percentage of variance accounted for by each of the correlated factors was 18.3, 5.5, 3.9, 3.8, 3.2, 2.5, 2.3, 1.8, 1.6 and 1.5 (contact author for details).

Stevens (p. 394, 1996) recommends that item factor loadings of .40 or greater for at least 10 items for a sample size of at least 150 are required for reliable factor determination. Components with at least four items with loadings above .60 are reliable, regardless of sample size. All nine identified factors in this study easily meet these guidelines while the eighth (Kinesthetic) and tenth factors (Intrapersonal) possess fewer than expected items and lowest factor correlations.

Highest item - factor comparisons across samples. To understand how congruent are item response patterns across cultures a review of items with the highest factor coefficients for each of the three samples are presented in Table 4. The question, *How similar are the response patterns when the English language and Translated versions are compared to the Original sample response patterns?* can be addressed by examining the item response patterns and item content across the three samples.

Table 4
Summary of Highest Item-Factor Coefficients Among Samples

Scale	N.A.	Study 1: English	Study 2:Translations
Interpersonal	10	8	8
Intrapersonal	8	7	7
Spatial	12	11	10
Linguistic	10	8	6
Math-Logic	10	8	9
Kinesthetic	7	6	6
Musical	10	9	9
Naturalist	10	9	9
Totals	77	66	64

N.A. = number of highest item coefficients for North American sample;
Study 1: English = number of items on English factor that are also on NA factor; *Study 2: Translation* = number of items on Translated factor that are also on NA Scale Factor.

For all eight scales, 86% (66 of 77) of highest English items also appear on the North American factor. Each of the eight scales differ by only one or two items. The content of the shared items that have the highest factor coefficients is also consistent between the two samples as compared with the original North American sample. 73% (27) of the shared highest items for each factor focus on assessing ability while 22% (8) inquire about participation and 5% (2) focus on expressed enthusiasm (details available from the author upon request).

Discussion

The psychometric results and factor analyses of Study 1 provide additional support for the multidimensionality of the MIDAS questionnaire. The English version mean scale scores are lower than the North American version by an average of 2% points ranging, from 0 to 3%. The Naturalist is lowest for both samples while the Interpersonal is highest for both. The item scoring patterns are likewise very similar for both versions. These differences are not meaningful given that the samples are not randomly selected and the pattern of mean scores is nearly identical for both versions.

The alpha reliability coefficients for the scales on English version are very close to the North American sample ranging from -.03 to +.01 in difference. All alpha values are strong ranging from .80 to .90. The lowest alpha value is for the Kinesthetic scale for both versions (.80, English and .79, North American) while the Linguistic and Naturalist scales are both the highest and identical, .90.

The content of the items with the highest factor coefficients are very similar between the English and North American versions with 86% agreement in question composition and 73% of questions focused on ability as compared with 66% of questions for the original.

Exploratory factor analyses for both English and North American versions identified an acceptable factorial solution that matched theoretical expectations but with some interesting differences. Initial factor structures with eigenvalues greater than 1 both

accounted for 56% of the variance but the NA sample identified 17 factors and the English sample identified 20. For both samples the Interpersonal and Intrapersonal scales merged until 9 and 10 factor solutions, respectively, were specified. This solution resulted in a split in the Spatial scale onto two factors for both versions while the Naturalist scale split for English and Translated versions but not the North American sample.

The content of the questions for the split Spatial scale for all three versions is very similar. The same is true for the split of the Naturalist scale. One Naturalist factor focuses on Animals while the other involves Science. There is much co-loading among items for these factors. One Spatial factor emphasizes Artistic activities while the second factor emphasizes Spatial Problem Solving for all three studies.

Overall, the statistical similarities and item content of the NA and English data are far greater than are their differences. Minor differences in factor structure (Intra and Inter factors merging and Naturalist splitting into two smaller factors) can logically be attributed to cultural differences. Largely similar response patterns in both content and structure provide confirmation of the cross cultural existence of the eight proposed constructs as measured by the MIDAS questionnaire.

Study 2 tests whether or not these similarities hold up when the wording of the questionnaire undergoes multiple translations and data is collected from a wide variety of cultures.

Study 2

Study 2 further examines the psychometric properties, factor structure and item response patterns of the translated versions of MIDAS completed by non-English speaking samples from nine different countries. The questionnaire was translated by local researchers as part of a doctoral program or for use in a school. A variety of standard translation procedures were employed but all procedures were reviewed and approved by the author prior to data collection. Typically, a translation was created and then independently reviewed by two bi-lingual educators. Differences were then reconciled prior to a small scale data collection. Item analyses were conducted and corrections to the translation were made prior to MIDAS use and large scale data collection. This process mirrored the procedures used during the initial development of the questionnaire.

Method

Participants

Participants came from nine different non-English speaking countries for a total of 2,908. There were 1,341 females (46%) and 1,069 males (37%) and 498 missing information. There were 617 teenagers, 1,945 university students and 346 adults. Exact ages were not recorded.

Teenage groups included the following grade levels: 340 10th, 15 11th and 163 12th. University students group included the following grade levels: 208 first year; 272 second year; 43 third year; 7 fourth year and 933 undifferentiated. The adult group included 198 nurses, 27 high school graduates, 42 with a university degree, 58 with a master degree, 3 graduates from a junior college and 2 with doctoral degrees (Table 5).

Table 5
Gender Age Levels of Participants from 9 non-English Speaking Samples

Country	Sex		Age			Total
	Female	Male	Teens	Adults	University	
Korea	169	172	0	0	341	341
Iran	134	21	0	0	380	380
Spain	194	95	0	0	289	289
Iceland	163	154	318	0	0	318
Puerto Rico	195	201	83	49	293	425
Chile	153	81	138	36	64	238
Argentina	279	299	0	0	578	578
Thailand			78	161	0	239
Turkey	54	46	0	100	0	100
Total	1341	1069	617	346	1945	2908

Procedure

Participants in this study were adults and teenagers who completed the MIDAS assessment translated into their native language over a period of 10 years. Participants in Spain, Puerto Rico, Chile and Argentina completed the same Spanish translation. Participants in Korea, Iran, Iceland, Thailand and Turkey completed the translated questionnaire as part of the validation process.

Results

Psychometric properties of MIDAS – translated versions, combined samples

Cronbach alpha coefficient reliabilities are reported in Table 2 ranging from a low of .80 (Kinesthetic) to a high of .90 (Linguistic). The mean scale scores for the eight scales range from 45% (Kinesthetic and Naturalist) to a high of 59% (Interpersonal) with a median of 49% (see Table 1). The mean item response values (scored 1 - 5) for the 117 questions ranged from a low of 1.6 to a high of 3.9 with a median of 2.9. The standard deviation for item responses ranged from .93 to 1.66 indicating that a full range of response choices were utilized.

Factor analysis of translated versions, combined samples

A principal components orthogonal analysis was initially applied to 117 items (two non-scored items removed) followed by varimax rotation. Twenty-one factors were identified with eigenvalues greater than one that accounted for 56% of the variance. The KMO test of sampling adequacy was .956. The scree plot and the descending pattern of eigenvalues suggested simple factor solutions ranging from five to ten with a pronounced

break at eight factors. The first 11 factors account for 45% of the variance include all eight of the hypothetical.

When either 8, 9 or 10 factor Promax solutions are specified the proposed Interpersonal and Intrapersonal constructs merge into one factor while the Spatial splits into two factors. The remaining factors are matched to the other six hypothetical factors. This is the same result as what occurred during original analysis of the North American sample and nearly the same as for the English language factor analysis.

In light of these data, an 11 factor principal components analysis with Promax (Kappa 4) rotation was specified. This analysis resulted in a simple structure accounting for 45% of the variance with a pattern of item correlations that match the eight proposed scales except that Spatial and Naturalist scales split into two factors each and the 11th factor is small and uninterpretable. The percentage of variance accounted for by each of the correlated factors was 19.0, 4.5, 3.9, 3.3, 3.0, 2.2, 2.1, 1.8, 1.7, and 1.6. (details available from author)

Highest Item-Factor Comparisons Across Samples

When we examine the items with highest factor coefficients for each of the three samples presented above in Table 4 we see that 83% (64 of 77) of the Translated items also appear on the North American sample list. These results are very similar to the comparison between the NA and English versions. The main difference is that there is greater variability for the Linguistic scale between the North American and Translated versions where there are four fewer shared items. As noted above the content for the eight scales among all three different versions shows a high degree of agreement (73% focus on Ability).

Discussion

The results of Study 2 provide additional support for the multidimensionality of the MIDAS across translations and cultures. The mean scale scores for the Translated samples show slightly greater variability than does the English version when compared to the North American sample, but these differences are not large. Scales mean differences range from 0 to -.4% and +3%. The pattern of high - low values, however, is identical among all three samples with lowest scores observed for Naturalist and Kinesthetic and highest scores for Interpersonal. Item response pattern values for the Translated version are nearly identical with the NA sample while small differences are observed when compared with the English version.

The alpha reliability coefficients for the scales on Translated version are very close to the North American sample ranging from -.03 to +.01 in difference. All alpha values are strong ranging from .80 to .90. The lowest alpha value is for the Kinesthetic scale for both versions (.80, Translated and .79, North American) while the Linguistic and Naturalist scales are both the highest and nearly identical, .89 and .90.

The content of the items with the highest factor coefficients are very similar between the Translated and North American versions with 83% agreement in question composition and 73% of questions focused on ability. Again we observed some greater

variability for the Translated version than the English version when compared to the original NA version.

Exploratory factor analyses for both Translated and North American versions identified an acceptable factorial solution that matched theoretical expectations but with some interesting differences. Initial factor structures with eigenvalues greater than 1 both accounted for 56% of the variance (the same for all three samples) but the NA sample identified 17 factors and the Translated sample identified 21. For both samples the Interpersonal and Intrapersonal scales merged until 9 and 11 factor solutions, respectively, were specified. This 11 factor solution replicated the split in the Spatial and Naturalist scales that occurred for the English version and both versions accounted for an identical 45% of the total variance. The Spatial scale split onto two factors for both versions with one factor emphasizing Artistic activities while the second factor emphasizes Spatial Problem Solving. One Naturalist factor focuses on Animals while the other involves Science. Again, there is much co-loading among items for these two Naturalist factors.

Overall, the statistical and content similarities of Translated version mirror the patterns observed between the NA and English samples. There is a fairly remarkable consistent pattern of responding by individuals of many ages, in many countries with differing education levels using a wide variety of languages. Minor deviations can easily be attributed to either cultural or linguistic differences. Structural differences are noteworthy but do not, in the final analysis, undermine the essential integrity of the proposed multiple intelligences model of human intelligence.

Summary and Conclusions

The goal of the present studies was to determine if the MIDAS questionnaire assesses the eight theoretical ability constructs as defined by multiple intelligences theory: linguistic, musical, kinesthetic, spatial, logical-mathematical, interpersonal, intrapersonal and naturalistic. In two large multi-country studies with sample sizes large enough to warrant the use of factor analyses nearly identical factor structures are observed. Structural differences are minimal and can be logically attributed to cultural influences. Scale mean scores and reliability coefficients are also mostly consistent across cultures and translations. Of particular note are two findings with education implications. The item response patterns among diverse populations are more alike than they are different and a majority of the key questions' content focuses on skills and abilities. These results indicate that the MIDAS is primarily an assessment of "abilities" as opposed to "interests" and these abilities are assessed in a consistent manner regardless of language and diverse cultural experiences.

This research, along with other international and criterion group studies, provides consistent empirical support from many different cultures for the multiple intelligences model of human intelligence as assessed by the MIDAS.

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Appendix

Description of the Multiple Intelligences

Intelligence	Description
Interpersonal	To think about and understand another person. To have empathy and recognize distinctions among people and to appreciate their perspectives with sensitivity to their motives, moods and intentions. It involves interacting effectively with one or more people in familiar, casual or working circumstances.
Intrapersonal	To think about and understand one's self. To be aware of one's strengths and weaknesses and to plan effectively to achieve personal goals. Reflecting on and monitoring one's thoughts and feelings and regulating them effectively. The ability to monitor one's self in interpersonal relationships and to act with personal efficacy.
Kinesthetic	To think in movements and to use the body in skilled and complicated ways for expressive and goal directed activities. A sense of timing, coordination for whole body movement and the use of hands for manipulating objects.
Linguistic	To think in words and to use language to express and understand complex meanings. Sensitivity to the meaning of words and the order among words, sounds, rhythms, inflections. To reflect on the use of language in everyday life.
Logical-Mathematical	To think of cause and effect connections and to understand relationships among actions, objects or ideas. To calculate, quantify or consider propositions and perform complex mathematical or logical operations. It involves inductive and deductive reasoning skills as well as critical and creative problem solving.
Musical	To think in sounds, rhythms, melodies and rhymes. To be sensitive to pitch, rhythm, timbre and tone. To recognize, create and reproduce music by using an instrument or voice. Active listening and a strong connection between music and emotions.
Naturalist	To understand the natural world including plants, animals and scientific studies. To recognize, name and classify individuals, species and ecological relationships. To interact effectively with living creatures and discern patterns of life & natural forces.
Visual-Spatial	To think in pictures and to perceive the visual world accurately. To think in three-dimensions and to transform one's perceptions and re-create aspects of one's visual experience via imagination. To work with objects effectively.

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