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Self-rated Estimates of Multiple Intelligences Based on Approaches to Learning.

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ABSTRACT

To date questionnaires that measure Multiple Intelligences (MIs) have typically not been systematically developed, have poor psychometric properties, and relatively low reliability. The aim of this research was to define the factor structure, and reliability of nine talents which are the behavioural outcomes of MIs, using items representing Approaches to Learning. Variability in talents based on the sex of respondents was also analysed. Analysis of the data from self-report questionnaires provided by 241 adolescents showed nine clear and reliable factors. The highest rated factors were Physical and Sport Activity, Musical and Rhythmic, followed by Construction and Spatial Design. Weak sex effects showed that males rated themselves higher on Mathematical and Logical, and Construction and Spatial Design factors and females rated themselves higher on the factors of Self-awareness, and Nature and the Environment. The factor structure and high internal consistency of factors of this instrument indicate that linking Approaches to Learning and MIs is a promising approach for further research.

Key words: multiple intelligences, talents, approaches to learning, sex and age effects

INTRODUCTION

The problem under investigation arises out of two longstanding problems in the field of multiple intelligences. The first problem is a paucity of information, methodologies, and approaches that describe the manner by which intelligence is nurtured and enhanced. As noted by Gardner (2003):

> Even though our efforts to understand intelligence have been advancing, we still know very little about how to nurture intelligence, be it conceptualized in unitary or pluralistic fashion, in individual-centered, contextualized, or distributed form. Yet surely our efforts to understand intelligence as scientists can best be crowned by a demonstration that intelligence can be nurtured in particular educational settings, using strategic pedagogical or facilitating techniques. Here lies one important challenge for the future (p. 4).

The second problem is a paucity of methodologies and approaches that investigate and measure the manner by which intelligence is systematically nurtured and enhanced. In an effort to address these problems the first aim of this paper is to investigate the factor structure of a new operationalization of MIs (Gardner, 1993, 2003). Investigating the links between talent, as a manifestation of multiple intelligence, and learning styles as a potential means of enhancing talent is the second aim. Such an

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investigation will advance knowledge about the ways in which individuals might acquire and maintain their talent, thereby addressing Gardner's concerns noted above. The third aim is to measure the relationship between the sex of respondents and age of respondents in an adolescent sample, using this new operationalization of MI.

Definition, Structure, and Reliability of MI

Over the last two decades one definition of intelligence has been refined to "a biopsychological potential to process information in certain ways, in order to solve problems or fashion products that are valued in a culture or community." (Gardner, 1999, p. 33-34; 1993). Recent descriptions of intelligence posit that intelligence does not occur in the head of the intelligent person but is essentially a part of the context within which the intelligence is applied (Gardner, 2003). This is a departure from the traditional definition and measurement of *g* and bears little resemblance to it (e.g. Colom, Juan-Espinosa, Abad, & Garcia, 2000). In line with Gardner, talent and ability are synonymous with and describe the functional transactions between the person and a situation that is available to everyone but actualized more frequently by only some people (Barab & Plucker, 2002). Recent research has proposed talents as the basis for acquiring and maintaining nine MIs: Language and Communication, Mathematical and Logical, Construction and Spatial Design, Physical and Sport Activity, Musical and Rhythmic, Social and Leadership, Self-awareness, Nature and Environmental, and Spiritual and Religious (Bowles, 2004). Talents have been defined as the behavioural representations of Gardner's Multiple Intelligences (1999). As such, talents are a discrete set of indicators of competence and intelligence in line with the theory of MIs (Gardner, 1999). Thus, where the MIs are cognitive functions the talents are the behaviours that indicate performance in intelligent activity - the manifest endpoint and product of a process that is behavioural and dependent on specific pre-existing cognate functions. To date there has been no operationalization of the nine proposed talents that has been statistically tested in a rigorous manner.

Nine independent talents are used in this research and represent all of the MIs described in the literature except Existential Intelligence. Gardner (1993) originally defined seven intelligences. In line with Gardner (1999) the definition of the two further talents of Nature and Environmental and Spiritual and Religious, have been included. Existential Intelligence was considered too difficult to operationalize (Gardner, 1999; 2000). Existential Intelligence was also considered an extension of Spiritual and Religious intelligence (Gardner, 1999) and Spiritual and Religious talent is the application of spiritual intelligence. Spiritual Intelligence is "Any discussion of the spirit - whether cast as spiritual life, spiritual capacity, spiritual feeling, or a gift for religion mysticism or the transcendent" (Gardner, 1999, p. 53). The ninth talent to be operationalized in this research is termed Nature and Environmental talent. It is "expertise in the recognition and classification of the numerous species – the flora and fauna - of his or her environment…extensive knowledge of the living world" (Gardner, 1999, p. 48). The nine talents and MIs are presented in Table 1.

Gardner (1999) carefully differentiates between intelligence and learning or working styles by describing a style as "a general approach that an individual can apply equally to an indefinite range of content" (pp. 83-84). Gardner's definition of learning or working styles is equivalent to the definition of an Approach to Learning as proposed by Bowles (2004). Approaches to Learning are the ways that people acquire and maintain their intelligence while talents are the ways in which intelligence is expressed (Bowles, 2004). The nine talents were used as contexts to elicit responses from an adult group who were asked to recall how people they knew, who were proficient or outstanding (in the nine individual talent areas), acquired and maintained their talent using an open-ended response format. The definition of seven separate Approaches to Learning emerged from the statements of respondents. These statements were Effort, Understanding, Interest, Natural Ability, Performance, Pre-occupation, and Ease. A summary of the association between the talents and Approaches to Learning (Bowles, 2004) showed that Effort, Understanding, and Interest were the three most frequently nominated Approaches to Learning describing the acquisition and maintenance of MIs. Effort was the most frequently associated Approach to Learning with a match to eight of nine talents, in particular, with Language and Communication, Mathematical and Logical, Physical and Sport Activity, and Musical and Rhythmic talents. Understanding was associated with Self-awareness and Spiritual and Religious talent. Interest was most associated with Nature and the Environment. The Approach to Learning of Pre-occupation was associated with Nature and the Environment; and, Natural Ability was associated with Mathematical and Logical, Musical and Rhythmic, and Social and Leadership talent.

Table 1: Definition of Nine Talents in Relation to Multiple Intelligences

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Talent	Gardner's MI Nomenclature	Stem Operationalizing the Talent
1) Language and Communication	Linguistic	Communicating ideas, discussing, creative & other writing, reading, acting, telling jokes, playing with language or word games.
2) Mathematical and Logical	Logical and Mathematical	Recognising patterns and relationships, 'cracking' codes, solving problems and number patterns or calculating complex problems.
3) Construction and Spatial Design	Visual and Spatial	Making models, drawing, imagining how to build things, reading maps, working with wood, other material or construction sets.
4) Physical and Sport Activity	Bodily-kinaesthetic	A Sport/s, exercise, aerobics, physical training, creative movement, dance, acting, miming or other physical activities.
5) Musical and Rhythmic	Musical and Rhythmic	Music, listening for relaxation or pleasure, rhythm patterns, music playing, performing, reproducing rhythm or pitch by singing or playing.
6) Social and Leadership	Interpersonal Intelligence	Group activities, clubs, cooperative tasks, being with others, community service activities, being responsible or being a leader.
7) Self-awareness	Intrapersonal Intelligence	Finding out about your own feelings and thoughts, focusing on your own behaviour and the behaviour of others, spending time by yourself, thinking about thinking.
8) Nature and Environmental	Naturalistic Intelligence	Looking after nature, being in nature, visiting places where animals live, finding out about the connections between environments and animals.
9) Spiritual and Religious	Existential Intelligence	Being aware of a spiritual self and world, involvement in different religious activities and tasks, being involved in spiritual celebrations and rites.

Performance was associated with Physical and Sport Activity. The least associated term with any of the talent areas was Ease which had a weak association with the talent of Self-awareness.

The seven Learning Approaches that emerged were clearly different from Biggs' motives and strategies (1987, 1996a, 1996b, 2001), the content of the Learning Styles Inventory - 1976/1984, (Kolb, 1976, 1984; Smith & Kolb, 1986), and different from Dunn and Dunn's explanation of learning styles (Dunn & Griggs, 2000; Dunn, Griggs, Olson & Beasley, 1995). The Approaches to Learning were very different from Denig's (2004) list of 21 learning styles, which are more likely to be learning preferences than learning styles. The Approaches to Learning were also distinct from the styles of engagement with learning defined by Ainley (1993) as Detached, Committed, Hopeful, Engaged, Disengaged, and Keen-to-do-Well. Of the indices and measures of learning styles (e.g., Biggs, 1976), only one measure (Snyder, 2000) has been found that expressly links learning styles with attention to MIs but the psychometric properties of the instrument were not reported. In line with previous research, it is expected that an association between Approaches to Learning and talents will be found. In particular, it is expected that Effort, Understanding, and Interest will contribute most to the talents.

Gardner (1999) maintains that it is important to ascertain the empirical linkages between learning or working styles and their association with specific intelligences. Doing so will assist in meeting one of the two main challenges facing MIs (Shearer, 2004). The first challenge is linking MIs with a valid representation of the mind/brain, which is not the focus of this research paper. The second challenge is demonstrating how effective MIs are in improving educational outcomes, learning and personal

achievement (Shearer, 2004). Measures of MIs typically have questionable operationalization and psychometric properties (e.g., McMahon, Rose, & Parks, 2004; Teele, 1992). Providing a measurement tool that links Approaches to Learning and MIs has not been the focus of previous research into either learning styles or MIs. Linking Approaches to Learning and MIs will advance knowledge about MIs as well as personal achievement. To provide this link a questionnaire was developed to provide a rating on each of the seven Approaches to Learning in reference to a description of each of the talents. By averaging the ratings of the seven Approaches to Learning related to each specific talent, nine indices of talent are produced. The rating generated by considering an Approach in reference to a specific talent is expected to be different for each talent. For example, a high rating on the Approach of Natural Ability with the talent of Physical and Sport will be different to a high rating of Natural Ability for Mathematical and Logical and will be manifest in different behavioural outcomes. Individuals who have high MIs as talents would be expected to rate several Approaches to Learning associated with that specific talent. For example, Natural Ability alone is a minimal requirement to be Musically and Rhythmically talented. To be very talented Musically and Rhythmically, a high rating on several of the Approaches to Learning would be expected. Correspondingly, it is expected that the seven Approaches to Learning associated with each talent will form a factor representing the underlying construct associating the Approaches to Learning and each talent. By averaging across the nine talent ratings a coefficient of the Total Talent of an individual can be produced. Thus, the first aim of this research is to describe the factor structure and reliability of a questionnaire operationalizing self-reports of nine MIs in relation to seven Approaches to Learning, and Total Talent.

There is evidence in the literature of sex effects associated with MIs. In research measuring the MIs of students from Poland, males were shown to have higher self-estimates than females on General, Spatial, and Musical intelligence (Furnham, Wytykowska, & Petrides, 2005). Other research measuring the talents of New Zealand students showed that males self-rated higher than females in Mathematical (logical), Spatial, and Existential intelligence (Furnham & Ward, 2001). In two studies of European respondents, adult males rated themselves higher than females on Logical/Mathematical (study 1) Logical/Mathematical and Spatial and Musical MIs (study 2; Furnham, Clark, & Bailey, 1999). In a similar study from the United States, adult males rated themselves higher than females on Logical/mathematical and females rated themselves higher on Intrapersonal MIs (Lorri, 2005). Other research has shown that male adolescents scored higher on Mathematical and Visuo-spatial with females self-rating higher than males on Musical and Intrapersonal intelligence (Furnham & Budhani, 2002). The sex differences reported in the literature, although consistent, are relatively small. In the current research sex differences are expected with males rating themselves higher on Mathematical and Logical talent, Construction and Spatial Design talent. It is also expected that females will have higher self-ratings than males on Self-awareness.

In this research the following hypotheses will be addressed:

- H1a. Nine underlying constructs will be defined by ratings of Approaches to Learning in relation to each talent.
- H1b. The Approaches to Learning of Effort, Understanding, and Interest will contribute most to the definition of the talents.
- H1c. The factors of the talents will be low to moderately correlated and demonstrate high internal consistency.
- H2. Males will have higher self-ratings than females on Mathematical and Logical talent, and Construction and Spatial Design talent. Females will have higher self-ratings than males on the Musical and Rhythmic talent, and Self-awareness talent.

METHOD

Participants

A total of 241 adolescent students from two secondary schools in the metropolitan region of Melbourne, Victoria participated in this research. One school was coeducational and the other was an all-female schools. Male and female students from the seventh and eight grade (the eighth and ninth year of compulsory schooling) participated. The mean age of the 118 males was 13.14 years (S*D* = 0.54) and the 123 females was 12.92 years (S*D* = 0.27). The age range was from 11 to 14 years with 82% of respondents being 13 years of age.

Procedure

Each respondent filled in the questionnaire in class groups under the supervision of the researcher and a school staff member. The researcher collected the questionnaire and the assent forms, from students and their parents, authorizing the research.

Questionnaire

A questionnaire booklet was constructed with a Likert-type scale of a different Approach to Learning heading each of seven pages. The seven approaches to learning were Interest, Ease, Effort, Understanding, Performance, Pre-occupation, and Natural Ability. Each of the approaches to learning have been previously described elsewhere (Bowles, 2004).

The instruction to participants was provided on the first page and the definition of each talent was listed on each page after a Likert-type scale. The stem defining and operationalizing the talents (Bowles, 2004) based on Gardner's MIs (1999, 2003) are listed in Table 1. Respondents were required to record their rating on a designated response sheet. On the following pages the same procedure was followed, with respondents asked to reply in reference to each talent. See the appendix for a sample page.

RESULTS

The data were screened in accordance with standard procedures recommended to evaluate the integrity of the data prior to the analyses (Hair, Anderson, Tatham, & Black, 1995; Tabachnick & Fidell, 1996). In both the univariate and multivariate preliminary analyses, the cell sizes were satisfactory and the standard deviations were within the acceptable range of distribution for all except two items. These items underwent transformations and analysis of this material differed little from the results obtained using the untransformed data indicating that transforming the items had no real impact on the results of analyses. Therefore, the untransformed data were used in the analyses reported here.

Factor analysis is recommended for determining the number and definition of factors representing underlying constructs when they are sufficiently independent of one another to indicate such constructs (Hair, Anderson, Tatham, & Black, 1995; Tabachnick & Fidell, 1996). The number of the factors of talents and the adequacy of their structure were assessed through the evaluation of eigenvalues, the scree plot, and analyses as recommended (Finch & West, 1997; Tabachnick & Fidell, 1996). Oblique rotation has been recommended to produce accurate estimates of true factors and simple structure when factors are expected to be correlated (Fabrigar, Wegener, MacCallum, & Strahan, 1999). As the nine factors being investigated here are expected to be independent (Gardner, 1999), factor extraction with varimax rotation, and maximum likelihood was performed on the 63 items. As expected, analyses revealed nine factors as shown by the scree plot and pattern matrix of the structure shown in Table 2. The factor solution accounted for 61.84% of the variance with consistently high loadings for each dimension. The items loaded on appropriate factors with sufficient definition and a minimum contribution of 0.44 or better. No individual items loaded on a second factor greater than .27. Inclusion at this level revealed that the best solution contained the correct Approach to Learning on each theoretically defined factor. The factor loading of each of the items was above the significance level for the sample size (Hair, Anderson, Tatham, & Black, 1995). Communality values for items ranged from moderate to excellent.

Interpretation of the eigenvalues of the items and communalities indicated that the theorized solution of nine factors was satisfactory. Inspection of the scree plot indicated that the best solution contained either 11 or 12 factors; however, the theorized solution was the most parsimonious with a distinct elbow after the ninth factor. The first latent factor was sufficiently defined and accounted for 17.89% of the variance and was Construction and Spatial Design. The subsequent factors contributed sufficiently to the communality with the lowest factor of Social and Leadership accounting for 3.21% of the variance, which is a sufficient amount for the weakest contributing factor.

Assessing the factorability via the correlation matrix requires inspection of the correlations, assessment of the overall significance of the correlation matrix using Bartlett's test of sphericity and assessing the measure of sampling adequacy (Hair, Anderson, Tatham, & Black, 1995; Tabachnick, & Fidell, 1996). The Kaiser-Meyer-Olkin measure of sampling adequacy was very good at .82. The Bartlett test of sphericity measures the overall significance of the correlation and showed adequacy (χ^2 (1, N = 241) = 9963.28, p = .001).

Table 2: Pattern Matrix of the Structure of Nine Talents

Factor – Talents	Factor Matrix of									
	1[1]	2	3	4	5	6	7	8	9	h^2
Construction and Spatial Design										
Performance	86									77
Natural Ability	85									76
Ease	77									62
Pre-occupation	74									58
Understanding	73									59
Interest	70									55
Effort	61									44
Natural and Environmental										
Performance		78								73
Effort		75			20					67
Interest		74							27	64
Natural Ability		73								63
Understanding		70			25					67
Ease		69								59
Pre-occupation		64							25	51
Musical and Rhythmic										
Performance			83							72
Natural Ability			81							68
Understanding			78							63
Interest			74							58
Ease			71							55
Pre-occupation			66							48
Effort			59							41
Physical and Sport Activity										
Performance				83						75
Interest				76						61
Understanding				73						58
Ease				72						58
Pre-occupation				68						49
Natural Ability				66						48
Effort				57						40
Spiritual and Religious										
Understanding					74	24	20			69
Performance					74					63
Natural Ability					71				22	58
Effort					67					57
Ease					66					50
Interest					66				23	51
Pre-occupation					56				23	41
Mathematical and Logical										
Ease						80				68
Understanding						79				66
Performance						74				63
Natural Ability						70				57
Interest						67				49
Effort						55				41
Pre-occupation	23					44				32
Social and Leadership										
Performance							74			66
Ease							68			51
Effort							68		20	56
Understanding					23		68			58
Natural Ability							66	25		58
Interest							63			50
Pre-occupation					22		55			42
Language and Communication										
Performance					21			76		66
Natural Ability								73		66
Ease								72		63
Understanding					26			68		59
Interest								55		36
Effort								51		33
Pre-occupation								47		28

Self-awareness										
Performance		21			21				68	64
Interest									65	50
Natural Ability									64	52
Pre-occupation					27				63	50
Effort									59	46
Ease									56	41
Understanding			20		21				49	40
Rotation Sums Squared Loading (cumulative %)	17.10	24.76	32.64	38.66	43.13	47.20	50.46	53.07	55.64	
Cumulative Eigenvalue (cumulative %)	17.89	26.59	34.87	41.48	46.64	51.36	55.29	58.63	61.84	

[1] Note: Decimal points have been removed and eigenvalues have been rounded to hundredths; values of 0.1 and above are included in the table.

The Pearson's correlations of factors (Table 3) show that the factors were weakly to moderately related, with 25 of 45 correlations being significant. The means and standard deviations of each factor revealed that Physical and Sport Activity, Musical and Rhythmic, and Language and Communication were the most highly rated talents. The lowest rating talent was Spiritual and Religious. All nine factors were at least moderately related to the Total Talent factors to a moderate level or better.

Table 3: Correlations, Means, and Standard Deviations for Nine Talents and Total Talent.

	1[a]	2	3	4	5	6	7	8	9	10
(1) Language and Communication		.33**	.14*	.27**	.11	.40**	.26**	.29**	.19**	.60**
(2) Mathematical and Logical			.24**	.13*	-.02	.24**	.22**	.28**	.24**	.54**
(3) Construction and Spatial Design				.17**	.05	.07	.00	.24**	.05	.44**
(4) Physical and Sport Activity					.23**	.31**	.01	.05	.01	.44**
(5) Musical and Rhythmic						.12	.24**	.06	.14*	.41**
(6) Social and Leadership							.31**	.28**	.37**	.63**
(7) Self-awareness								.42**	.44**	.58**
(8) Nature and Environmental									.38**	.64**
(9) Spiritual and Religious										.58**
(10) Total Talent (mean)										
Scale Mean	22.83	20.28	24.04	28.08	25.87	22.90	18.73	20.53	15.79	22.12
Scale *SD*	5.21	5.40	6.71	5.75	6.30	5.77	5.31	6.55	5.73	3.14
Cronbach's Alpha	.85	.87	.91	.88	.90	.88	.85	.91	.88	.92

Note. [a] Numbers have been rounded to hundredths for the correlations. * Significance of less than or equal to .05 (2-tailed); ** significance of less than or equal to .01 (2-tailed).

ANOVAs were used to test differences between the sex of the respondents (IV) on the nine talents (DVs). The results of evaluations of the assumptions of normality, linearity and mulitcollinearity of the relevant variables were satisfactory. Table 4 shows the factor labels and the arrangement of the sex effect, the mean differences and standard deviations for each of the main effects and interactions, the *F* ratio and the significance of the difference and partial eta squared. Analysis showed that there was a significant sex difference for Mathematical and Logical, Construction and Spatial Design, Physical and Sport Activity (approaching significance) with males rating higher. Females had a significantly higher rating of Self-awareness and Nature and Environment talent. The magnitude of the significant effects ranged from weak to negligible.

The three highest rating talents, for both males and females were Physical and Sport, Musical and Rhythmic, and Construction and Spatial Design (figure 1). The lowest rating talents (averaged over sex) were associated with Mathematical and Logical, Self-awareness, and Spiritual and Religious.

Table 4: Between Group Analyses of Talents by the Sex and Age of Respondent.

Factor Labels	Elements of the Variation				Univariate Significance		
	Females		Males				
	Mean	*SD*	Mean	*SD*	*F*	*p*	η^2
Language and Communication	23.33	5.24	22.30	5.14	2.40[a]	.123	.01
Mathematical and Logical	19.28	4.75	21.32	5.85	8.85	.003	.04
Construction and Spatial Design	22.92	6.72	25.22	6.52	7.21	.008	.03
Physical and Sport Activity	27.38	5.91	28.81	5.53	3.76	.054	.02
Musical and Rhythmic	25.70	5.91	26.05	5.53	0.19	.666	.01
Social and Leadership	23.28	5.51	22.50	6.04	1.11	.293	.00
Self-awareness	19.50	5.41	17.93	5.11	5.30	.022	.02
Nature and Environment	21.50	6.60	19.51	6.38	5.68	.018	.02
Spiritual and Religious	15.68	5.43	15.91	6.06	0.09	.763	.00
Total	22.06	3.09	22.17	3.21	0.07	.794	.00

Note. [a] For each ANOVA, $F(1, 139)$.

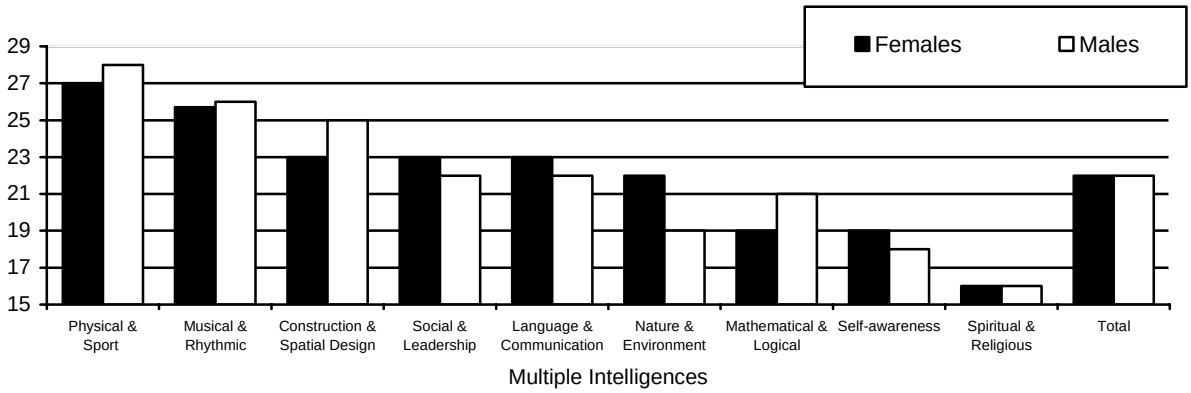

Figure 1. Comparison of the sum of item scores for each talent by the sex of respondent and the total talent score.

DISCUSSION

In summary, the results showed that nine talents defined by ratings of Approaches to Learning emerged from the factor analysis. As expected the Cronbach's alpha reliability of each factor was consistently high. Males had a statistically significantly higher rating on talents of Mathematical and Logical, and Construction and Spatial Design. Females had higher ratings on the talents of Self-awareness and Nature and Environment. The correlations between talent factors were weak and the rank order revealed a preference for Physical and Sport, Musical and Rhythmic, and Construction and Spatial Design. Each of these findings will be discussed in turn.

The aim of this research was to define the underlying structure of the talents operationalizing the MIs by using Approaches to Learning (Bowles, 2004; Gardner, 1999). As hypothesized, the results have shown nine talents, based on and synonymous with Multiple Intelligences, emerged from the factor analysis. As expected, the nine factors were parsimonious, with the appropriate items loading on the respective talents. The first talents to emerge from the analyses were Construction and Spatial Design, followed by Natural and Environmental. In reference to the item-factor association, an excellent variable to factor loading is considered .71 or better, .63 or better is very good, .55 or better is good, .45 or better is fair and .32 is poor (Comrey & Lee, 1992). The large majority of the loadings were excellent (81%), 14% were very good, and 5% were good. The lowest variable to factor loading

score was for the item of Preoccupation loading on the Mathematical and Logical factor with .44, which was low and relatively poor compared with other loadings. In line with Gardner's (1999) suggestion that the MIs are independent, there were low correlations associating the factors, justifying the use of varimax rotation with maximum likelihood. Thus, the first aim of constructing a measure of talents based on MIs (Gardner, 1993; 2003) in reference to Approaches to Learning (Bowles, 2004) has been shown to be promising, systematic and able to be operationalized.

The order of the items in the factors varied from what was expected. Performance was expected to be, and was found to be, associated with Physical and Sport Activity and was consistently high ranking compared with other Approaches to Learning. It was also the primary loading approach to learning for seven of the nine talents. Effort consistently ranked lowest or low in comparison with other Approaches to Learning. The association between Natural Ability with Musical and Rhythmic, Language and Communication, and Construction and Spatial Design was high. As expected, Understanding ranked as the highest approach to learning on Spiritual and Religious but lowest on the talent of Self-awareness. Interest loaded second highest on Self-awareness and Physical and Sport Activity, and third highest on Natural and Environmental talent, similarly Pre-occupation was low ranking on Natural and Environmental talent. The relationship between item and factors compared with previous research is probably due to sample effects as the previous research involved an older sample (Bowles, 2004).

The coefficient alpha for the factors is a measure of the reliability of the items' contribution to the internal consistency of the factor (Yarenko, Harari, Harrison & Lynn, 1986). The Cronbach's alphas for each of the factors ranged from .85 to .92, and the Total talent alpha was .92. The coefficient alphas obtained from the respondents for each of the factors was well above.70, which is recommended by Nunnally (1978). This indicates that the internal consistency of the factors is very high, as anticipated.

Concerning the expected sex effects, various significant differences between the pairs of means were found. Males rated themselves higher than females on Mathematical and Logical talent in line with previous research (Furnham & Budhani, 2002; Furnham, Clark, & Bailey, 1999; Furnham & Ward, 2001; Loori, 2005). Males rated themselves higher than females on Construction and Spatial Design talent, in line with previous research (Furnham & Budhani, 2002; Furnham, Clark, & Bailey, 1999; Furnham & Ward, 2001; Furnham, Wytykowska, & Petrides, 2005). Females rated themselves higher on the Self-awareness talent, which is in line with previous research (Furnham & Budhani, 2002; Loori, 2005). Females also rated themselves higher on Nature and Environment. Males did rate themselves higher than females on Musical and Rhythmic talent but not to a significant degree, which was contrary to previous research (Furnham & Budhani, 2002; Furnham, Clark, & Bailey, 1999; Furnham, Wytykowska, & Petrides, 2005). Importantly, the magnitude of the difference between respondents based on the sex of respondent was weak ($\eta^2 < .04$), indicating that there are consistent, small differences between males and females on four of the nine talents. These small differences hold some consistency with the findings of previous research. Given the small magnitude of differences between males and females it is likely that there will be variability between the sexes depending on context variables such as school type, and school specific factors such as a focus on sports, science, or the arts.

These findings should be accepted with caution. The measuring instrument is new, and although promising, it requires further validation against other measures and confirmation of the factor structure. The sample used in this research consisted of a cohort of young adolescents with a small age range and so may not represent typical adolescent behaviour. Further, the sample was drawn from a convenience sample of two schools with possibly different cultures and educational emphases, thus the results may not generalize to other settings.

Gardner's MIs have been extensively applied to the curriculum of school in many countries throughout the world, which is a testament to its utility in providing a framework to conceptualize expressions of talent. By better defining the talents, establishing their independence, and the sex differences associated with specific talents their utility in schools, in particular in secondary school settings, has been enhanced. Importantly, by establishing the powerful association between the talents and the Approaches to Learning teachers now have the opportunity to better focus teaching methods to facilitate learning approaches and through those approaches focus on talent development in their students. Providing information about a student's Talents and Approaches to Learning also allows educators and students to have information to clarify perceptions and misperceptions of talent and its expression.

Future research might focus on the effect of age or stage of education on students' perceptions of their educational experience, which may change as they develop (Midgley & Urdan, 1992; Hoose, & Strahan, 1988). Similarly, identifying the rank preference of talents of people of different age groups, particularly students, will assist in modelling the relationship between learning and talents more precisely. Applying the talents to the teaching and learning process in conjunction with the Approaches to Learning may lead to demonstration that intelligence can be nurtured in particular educational settings, using strategic pedagogical or facilitating techniques (Gardner, 2003). Further analysis of the higher order structure of the talents is warranted. The use of structural equation modelling may be one way to validate the structure of talents described in this research.

In conclusion, this research has shown that talents, as behavioural outcomes of MIs, can be defined by referring to the Approaches to Learning that assist in learning and maintaining talents. It has also provided initial evidence of the operationalization and psychometric properties of the questionnaire to assess this link. The research has confirmed and advanced knowledge of sex and developmental effects related to talent acquisition and maintenance. Generally, the research has provided a framework from which improvements to educational outcomes based on MIs may be made more possible (Shearer, 2004).

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APPENDIX

INTEREST INVENTORY

This questionnaire asks about your interests, abilities and activities in nine particular areas. Each page begins with a question which can be answered in regard to all nine areas. Respond to each statement using the **SCALE** from one to five on each page. Put the number indicating your response in the appropriate square on the answer sheet.

There is a different **SCALE** on each page. Each page is a new column on the answer sheet.

IN WHICH OF THE SETS OF ACTIVITIES ARE YOU INTERESTED:

	Not			Extremely
SCALE	**INTERESTED**	**INTERESTED**		**INTERESTED**
	1	2	3	4 5

(You do not have to be interested in all of the activities in each numbered group, just most of them.)

1.1
Communicating ideas, discussing, creative & other writing, reading, acting, telling jokes, playing with language or word games.

1.2
Recognising patterns and relationships, 'cracking' codes, solving problems and number patterns or calculating complex problems.

1.3
Making models, drawing, imagining how to build things, reading maps, working with wood, other material or construction sets.

1.4
A Sport/s, exercise, aerobics, physical training, creative movement, dance, acting, miming or other physical activities.

1.5
Music, listening for relaxation or pleasure, rhythm patterns, music playing, performing, reproducing rhythm or pitch by singing or playing.

1.6
Group activities, clubs, cooperative tasks, being with others, community service activities, being responsible or being a leader.

1.7
Finding out about your own feelings and thoughts, focusing on your own behaviour and the behaviour of others, spending time by yourself, thinking about thinking.

1.8
Looking after nature, being in nature, visiting places where animals live, finding out about the connections between environments and animals.

1.9
Being aware of a spiritual self and world, involvement in different religious activities and tasks, being involved in spiritual celebrations and rites.