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ABSTRACT

The purpose of this study was to assess the role of H. Gardner's (1983) theory of multiple intelligences in determining levels of statistics anxiety by correlating each of his dimensions of intelligence with six components of statistics anxiety. Participants were 90 graduate students from a variety of disciplinary backgrounds enrolled in 4 sections of an educational research methodology course. A canonical correlation analysis revealed that students who were less oriented toward linguistic and logical-mathematical intelligence and more oriented toward spatial and interpersonal intelligence tended to have higher levels of statistics anxiety. These findings highlight the potential utility of empirical research in the area of multiple intelligences. Implications for future research are discussed. (Contains 1 table and 20 references.) (Author)

# The Role of Multiple Intelligences in Statistics Anxiety

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Abstract

The purpose of this study was to assess the role of Gardner's (1983) theory of multiple intelligences in determining levels of statistics anxiety by correlating each of his dimensions of intelligence with six components of statistics anxiety. Participants were 90 graduate students from a variety of disciplinary backgrounds, enrolled in four sections of an educational research methodology course. A canonical correlation analysis revealed that students who were less oriented toward linguistic and logical-mathematical intelligence and more oriented toward spatial and interpersonal intelligence tended to have higher levels of statistics anxiety. These findings highlight the potential utility of empirical research in the area of multiple intelligences. Implications for future research are discussed.

The Role of Multiple Intelligences in Statistics Anxiety

Statistics anxiety has been found to be a psychological barrier to achievement in both statistics (e.g., Zeidner, 1991) and research methodology courses (Onwuegbuzie, 1997). Statistics anxiety has been defined as an anxiety which occurs as a result of encountering statistics in any form and at any level (Onwuegbuzie, DaRos, & Ryan, 1997).

Using factor analysis, Cruise, Cash, and Bolton (1985) identified six components of statistics anxiety, namely: (1) Worth of Statistics, (2) Interpretation Anxiety, (3) Test and Class Anxiety, (4) Computational Self-Concept, (5) Fear of Asking for Help, and (6) Fear of Statistics Teachers. According to Cruise et al. (1985), *Worth of statistics* refers to a student's perception of the relevance of statistics. *Interpretation anxiety* is concerned with the anxiety experienced when a student is faced with making a decision from or interpreting statistical data. *Test and class anxiety* refers to the anxiety involved when taking a statistics class or test. *Computational self-concept* involves the anxiety experienced when attempting to solve mathematical problems, as well as the student's perception of her/his ability to do mathematics. *Fear of asking for help* measures the anxiety experienced when asking a fellow student or professor for help in understanding the material covered in class or any type of statistical data, such as an article or a printout. *Fear of statistics teachers* is concerned with the student's perception of the statistics instructor.

Unfortunately, limited research exists on the characteristics of students with high levels of statistics anxiety (Auzmendi, 1991). Since researchers have found a relationship between cognitive ability and various types of anxiety (e.g., Hill, 1976), intelligence may be one of the factors involved in statistics anxiety. Some have proposed that intelligence is a multidimensional construct which accounts for individuals' diverse abilities to acquire and to create domains of knowledge (Gardner, 1983). According to Gardner (1983), there are seven intelligences (i.e., logical-mathematical, linguistic, spatial, musical, bodily-kinesthetic, interpersonal, and intrapersonal), each of which all normal individuals possess to some extent and which can be used to predict occupational and academic aptitudes. In addition, Gardner and Hatch (1989) suggest that strength in a particular intelligence category can guide a student toward a particular field of study. With regard to statistics, it is possible that persons with certain combinations of intelligences may experience different levels of anxiety. Indeed, Onwuegbuzie et al. (1997) found that students with high levels of statistics anxiety frequently reported that statistics is far removed from their field of study and that, consequently, they have difficulty adapting their cognitive set to the learning of statistics. Thus, this investigation was designed to identify a combination of intelligences which might be related to a combination of statistics anxiety measures, through canonical correlation analyses. Canonical correlation is a statistical technique which breaks down the association between two sets of variables and is appropriate for describing the number and nature of mutually independent relationships between the sets (Stevens, 1986).

Ninety graduate students from a number of social and behavioral science disciplines at a large midsouthern university were administered the Statistics Anxiety Rating Scale (STARS) and the Teele Inventory for Multiple Intelligences (TIMI) during the first class session of a research methodology course. The STARS, which was developed by Cruise and Wilkins (1980), is a 51-item, 5-point Likert-format instrument which assesses statistics anxiety in a wide variety of academic situations. This instrument has six subscales, namely, "worth of statistics," "interpretation anxiety," "test and class anxiety," "computational self-concept," "fear of asking for help," and "fear of the statistics instructor." A high score on any subscale represents high anxiety in this area. The Teele Inventory for Multiple Intelligences (TIMI; Teele, 1995), has been utilized in a variety of applications at the pre-school, elementary, and secondary levels, as well as at institutions of higher learning. The TIMI is a forced-choice inventory of 56 numbered pictures representing characteristics of each of the seven intelligences. Evidence of reliability has been reported for both the STARS (Cruise et al., 1985) and the TIMI (Teele, 1995).

A canonical analysis yielded one significant canonical function ($R_c$ = .51,

$p < .05$), which contributed approximately 26% (i.e., $R_c^2 = .51^2 = .26$) to the shared variance. All subsequent canonical functions were not significant ($p > .05$). The redundancy estimate (Table 1), which is equal to the average of the squared multiple correlation of each of the variables in one set with all the variables in the other set, indicates that, on average, 6% of the total variance in the set of anxiety components was accounted for by the linear combination of multiple intelligences. Furthermore, 5% of the multiple intelligence set variance was accounted for by a linear combination of the anxiety set. The adequacy estimate measures the degree to which each set's variance is represented in the canonical solution. The adequacy estimates in Table 1 indicate that 23% of the total anxiety set variance was represented in that set's canonical composite, and 20% of the multiple intelligence set variance was represented in its composite. Together, these results indicate a small to moderate overlap between the anxiety and multiple intelligence clusters.

An examination of the correlations between the variables and the canonical variates (i.e., structure coefficients) revealed that, using a cutoff correlation of 0.3 recommended by Lambert and Durand (1975) as an acceptable minimum loading value, the following multiple intelligence variables correlated with the first canonical variate: linguistic (.45), logical-mathematical (.74), spatial (-.41), and interpersonal (-.64). Of the six anxiety components, the following four correlated with the first canonical variate: Worth of Statistics (-.55), Interpretation Anxiety (-.49), Test and Class Anxiety (-.46), and Computational Self-concept (-.76). These variables contributed relatively larger amounts to the shared variation than did the other anxiety or multiple intelligence variables.

The square of the structure coefficients (Table 1) indicates that 20% of the variance in linguistic, 55% of the variance in logical-mathematical, 17% of the variance in spatial, and 41% of the variance in interpersonal were accounted for by the multiple intelligence cluster. Also, 30% of the variance in worth of statistics, 24% of the variance in interpretation anxiety, 21% of the variance in test and class anxiety, and 58% of the variance in computational self-concept were accounted for by the statistics anxiety cluster. Overall, the canonical correlation analysis suggests that students who were less oriented toward linguistic and logical-mathematical intelligence and more oriented toward spatial and interpersonal intelligence tended to have higher levels of interpretation anxiety, test and class anxiety, and anxiety stemming from a lack of perceived usefulness of statistics and from a lack of computational self-concept.

With respect to the relative importance of the variables, computational self-concept was the primary contributor to the anxiety cluster (58% of the variance being explained). In addition, worth of statistics, interpretation anxiety, and test and class anxiety made a moderate contribution. With regard to the multiple intelligence cluster, logical-mathematical and interpersonal made the biggest contribution (55% and 41%, respectively, of their variance being explained by the multiple intelligence cluster), with linguistic and spatial making a moderate contribution.

The above findings might reflect how statistics typically is taught, as well as how it is perceived by students. With respect to the former, statistics often is taught in ways that are better suited to students with logical-mathematical and linguistic orientations. In particular, statistics instructors may be placing too much emphasis on formulas, symbols, notations, and conventions--with insufficient emphasis on visual-spatial awareness. Thus, it may be helpful to make use of flow charts in introducing statistical concepts such as analysis of variance. In addition, statistics instructors should consider using concept mapping, since, in teaching other scientific concepts, this has been found to reduce levels of anxiety (Jegede, Alaiyemola, & Okebukola, 1990; Okebukola & Jegede, 1989), as well as to improve the quality of learning (Schmid & Telaro, 1990). Concept mapping is a technique of graphically representing concepts and their hierarchical inter-relationships among two or more dimensions, thus inducing students to plot concepts and their inter-relationships in a meaningful visual network (Schmid & Telaro, 1990). That is, a person learns concepts by consciously identifying logical relationships between the new concepts and concepts already known. In this respect, concept mapping should allow students to learn the language patterns of statistics, as well as to construct statistical knowledge.

According to Donovan (1983), steps in concept mapping include: (1) identifying important concepts in the area of study; (2) ranking concepts from the most general to the most specific; and (3) visually arranging concepts and specifying the connections between related concepts. Indeed, Fraser (1993) asserts that concept mapping allows individuals to communicate their understanding of their knowledge and to create shared understanding. This latter aspect may be particularly beneficial for students who are oriented toward interpersonal intelligence.

Semantic networking may be particularly useful for students who are more oriented toward spatial intelligence, since it attempts to capture the position of each concept in space (Fisher, 1990). In fact, computer software, such as the SemNet-super(TM), can be utilized as an instructional tool, since students can readily map concepts in many dimensions, as well as integrate concepts across a large knowledge base (Fisher, 1990). Such software not only allows one to create concept maps rapidly, but can be utilized easily by students as a self-study tool.

Thus, it is likely that the use of concept mapping, semantic networking, flowcharts, and the like, will be useful for students with intelligences which are not typically tapped in statistics--that is, those students who were identified in the present study as having relatively high levels of statistics anxiety.

In any case, more research is needed on how these techniques, as well as others, accommodate different intelligences in teaching statistical concepts to students.

A limitation of the present study is the relatively small sample used. These results, therefore, need to be replicated with larger samples, as well as using other populations, such as undergraduate students. Nevertheless, this study highlights the potential utility of empirical research in the area of multiple intelligences. An important implication of these findings is that, when introducing statistical concepts, instructors should be sensitive to the possibility that intelligence orientation may play a role in determining levels of statistics anxiety, and, as such, attempt to provide learning experiences which cater to as many different types of intelligences as possible. Indeed, when instruction is matched to identified learning style (Lenehan, Dunn, Ingham, & Signer, 1994) or when students are grouped with peers who perceive and process materials in a different way (Price, 1991), situation-specific anxiety levels appear to attenuate. Consequently, focusing on statistical content alone and not attempting to cater to a variety of intelligences may result in unnecessary levels of anxiety in statistics and research methodology classes.

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*Table 1*

*Canonical Analysis of Multiple Intelligence and Anxiety Variables*

| | Function 1 Coefficients | |
|---|---|---|
| Variable | Structure | $Structure^2$ |
| *Statistic Anxiety (STARS):* | | |
| Worth of Statistics | -.55* | .30 |
| Interpretation Anxiety | -.49* | .24 |
| Test and Class Anxiety | -.46* | .21 |
| Computational Self-concept | -.76* | .58 |
| Fear of Asking for Help | -.09 | .01 |
| Fear of Statistics Teachers | .11 | .01 |
| Adequacy (mean of $structure^2$) | | .23 |
| Redundancy (Adequacy x $R_c^2$) | | .06 |
| *Multiple Intelligence Variables (TIMI)* | | |
| Linguistic | .45* | .20 |
| Logical-Mathematical | .74* | .55 |
| Intrapersonal | -.02 | .00 |
| Spatial | -.41* | .17 |
| Musical | -.03 | .00 |
| Bodily-Kinesthetic | -.22 | .05 |
| Interpersonal | -.64* | .41 |
| Adequacy (mean of $structure^2$) | | .20 |
| Redundancy (Adequacy x $R_c^2$) | | .05 |

* significant loadings

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