Statistics Anxiety and Mathematics Anxiety: Some Interesting Differences I

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Abstract

Statistics anxiety is hypothesized to be a closely related but a distinct construct from mathematics anxiety. However, many incorrectly conceive that statistics anxiety is the same construct as mathematics anxiety. Confusing statistics anxiety and mathematics anxiety is common among students as well as researchers. Frequent appearance of statistics courses within mathematics departments and statistically significant relationships between mathematics anxiety and statistics anxiety are two main reasons for this confusion. The present paper discusses current literature and points out similarities as well as differences between statistics anxiety and mathematics anxiety. The need for future correlational and factor analytic studies that empirically examine the relationship between the measures of statistics anxiety and mathematics anxiety is noted.

Introduction

Statistics should be an integral part of all citizens' education. However, student difficulties with current statistics courses are noted in the literature. The majority of college students experience high levels of statistics anxiety (Birenbaum & Eylath, 1994; Gal & Ginsburg, 1994; Onwuegbuzie, in press, 1997a, 1997b; Perney & Ravid, 1990; Schau, Stevens, Dauphinee, & Del Vecchio, 1995). Many students regard statistics as the most difficult and least pleasant course (Berk & Nanda, 1998); complain about its mathematical nature; and the lack of appropriate skills (Johnson, 1999).

It has been hypothesized that most student difficulties in statistics may not be a result of insufficient intellectual ability or aptitude; rather, they may be reflections of attitudinal factors such as misconceptions (Barkley, 1995), negative attitudes (Wise, 1985), and anxiety (Gal & Ginsburg, 1994). Hence, statistics anxiety was defined as another type of situation-specific anxiety. Cruise, Cash, and Bolton (1985) observed that students who had difficulties in statistics exhibited characteristics different from students who had difficulties in mathematics. Thus, they asserted that statistics anxiety should be defined as a separate construct. They defined it as "feelings of anxiety encountered when taking a statistics course or doing statistical analyses; that is, gathering, processing, and interpret[ing]" (p. 92).

Statistics anxiety is a relatively newer construct and has not been investigated fully. Many, students and researchers alike, incorrectly conceive that statistics anxiety is the same construct as mathematics anxiety (e.g., Demaria-Mitton, 1987; Murdock, 1982; Yeger & Wilson, 1986). For example, Demaria-Mitton (1987) used a mathematics anxiety scale to measure statistics anxiety because she believed that statistics anxiety and mathematics anxiety were identical. She alleged that "… since statistics, like mathematics, is a number and symbol system requiring thinking on an abstract level…" she could conclude the two to be identical (1987, p. 20). Her reason for equating mathematics anxiety and statistics anxiety also came from Murdock (1982), who claimed that mathematics anxiety was the primary "cause" of statistics anxiety. However, Murdock (1982) did not establish a cause-and-effect relationship in his study and therefore causal conclusions were not possible from his study. Such claims that statistics anxiety and mathematics anxiety are the same constructs were later rejected (e.g., Birenbaum & Eylath, 1994) and differences between statistics anxiety and mathematics anxiety were detected (e.g., Onwuegbuzie, 1993).

Differences Between Statistics Anxiety and Mathematics Anxiety

Even though statistics anxiety and mathematics anxiety are related, statistics anxiety is hypothesized to be a distinct construct from mathematics anxiety (Balo_lu, 2001, Benson, 1989; Benson & Bandalos, 1989; Birenbaum & Eylath, 1994; Cruise et al., 1985; Onwuegbuzie, 1993, 1999a; Zeidner, 1991). Nonetheless, the nature of statistics anxiety and its relationships with other related constructs have not been fully investigated. Thus, "while it would appear reasonable to postulate that a relationship exists between mathematics anxiety and statistics anxiety, there is no research which demonstrates the specific degree to which this is a correct assumption" (Wentzel, 1998, p. 3). On the contrary, Onwuegbuzie (1993) concluded that "…there is little doubt that statistics anxiety needs to be considered and measured separately" (p. 81). No work took place after Cruise et al.'s descriptive definition in 1985 that investigated specific differences between mathematics anxiety and statistics anxiety.

There is a major difference between mathematics and statistics regarding the cognitive processes involved in the fields of mathematics and statistics. According to Cruise et al (1985), statistics involves different mental procedures and requires more than manipulation of mathematical symbols. Buck (1987) explained that even though statistics employs basic mathematical concepts, it is more closely related to verbal reasoning than mathematical reasoning. Similarly, Zerbolio (1999) emphasized that to solve statistical problems, one uses more logical skills than mathematics skills. Moreover, cognitive processes involved with statistics anxiety may be different from cognitive processes involved with mathematics anxiety. Birenbaum and Eylath (1994) and Barkley (1995) found that, unlike mathematics anxiety, statistics anxiety was significantly correlated with inductive reasoning ability. In this sense, as opposed to Widmer and Chavez's claim (1986, p. 70) that "statistics anxiety is a specific form of math[ematics] anxiety," the concept of statistics anxiety may be broader than that of math[ematics] anxiety (Bradstreet, 1996; Cruise et al., 1985). Onwuegbuzie comments that "…students with high levels of math[ematics] anxiety tend to have high levels of statistics anxiety, but the converse is not necessarily true" (1999b, p. 1).

The conflicting results regarding the relationships between statistics anxiety and mathematics anxiety may be due to two main reasons. First, there are numerous empirical studies that investigated mathematics anxiety; however, statistics anxiety has received little attention (Onwuegbuzie, 1998; Wentzel, 1998). Birenbaum and Eylath (1994) targeted the widespread fallacy, "mathematics and statistics are the same," as one of the reasons for the lack of research interest on statistics anxiety. Secondly, there has been no agreement regarding the nature of statistics anxiety.

Studies that used modified versions of mathematics anxiety instruments such as Statistics Anxiety Inventory-SAI (Zeidner, 1991) and the Statistics Anxiety Scale-SAS (Betz, 1978) found the nature of statistics anxiety to be similar to that of mathematics anxiety (e.g., Auzmendi, 1991; Pretorius & Norman, 1992; Wentzel 1998; Zeidner, 1991). For example, Zeidner (1991) replaced the word "mathematics" with the word "statistics" in a 40-item version of the MARS (Richardson & Woolfolk, 1980) and labeled it the SAI. The SAI is a 40 item, 5-point, Likert-type instrument that measures two primary factors such as statistics course anxiety and statistics test anxiety. The SAI scores vary between 40 and 200, higher scores refer to higher levels of statistics anxiety. Construct validity of the SAI was investigated by using a sample of 431 Israeli undergraduate, social science majors. After a principal-axis factor analysis with squared multiple correlations used as initial communality estimates, two factors were found to account for 45% of the total variance. These two factors are Statistics Test Anxiety (24%) and Statistics Course Anxiety (21%).

Additionally, he reported the SAI as having an internal consistency of .94 for the Statistics Content and .92 for the Statistics Test Anxiety scales. Zeidner (1991) found that statistics anxiety was positively related with mathematics anxiety (r = .41, p < .001).

Betz (1978) adapted the Mathematics Anxiety Scale-MAS (Fennema & Sherman, 1976) to measure statistics anxiety by replacing the word "mathematics" in some of the MAS items with the word "statistics." The SAS is a 10-item, 5-point, Likert-type instrument that assesses anxiety related to statistics. Construct validity of the SAS was investigated through a principal component analysis with a varimax rotation, which suggested a single-factor accounted for 91% of the variance in the SAS scores (Pretorius & Norman, 1992). A predictive validity investigation also revealed that the SAS discriminated between successful and unsuccessful students (t = 2.25, p < .05), where successful students had lower statistics anxiety scores (Pretorius & Norman, 1992). The SAS' concurrent validity was tested through seeking its relationship with the STAI (Spielberger, Gorsuch, Lushene, 1970). This relationship was found to be statistically significant (r = .26, p < .05). Betz (1978) also reported a high reliability of the SAS (r = .92). Also, Pretorius and Norman (1992) reported that the SAS had an internal consistency of .90, and a 3-month interval test-retest reliability of .75.

Cruise et al. (1985) posited that existing mathematics anxiety instruments may not be able to measure statistics anxiety accurately. Eighty-nine items were generated to quantify student anxieties when taking statistics courses or doing statistical analyses. These items were given to 1,150 university students who were enrolled in statistics courses. A principal components analysis with a varimax rotation of the original items revealed 51 items and six factors: Worth of Statistics; Interpretation Anxiety; Test and Class Anxiety; Computational Self- Concept; Fear of Asking for Help; and Fear of Statistics Teachers. Hence, the STARS is a51-item STARS, a 5-point, Likert-type assessment instrument that measures statistics anxiety in two parts. The first part includes 23 statements that are related to statistics anxiety; and, the second part includes 28 items that are related to dealing with statistics. In all the scales, the items are rated between "No Anxiety (1)" and "Very Much Anxiety (5)," where higher scores indicate higher levels of statistics anxiety.

The Worth of Statistics scale assesses the perception of the relevance of statistics. This scale includes items 24, 26, 27, 28, 29, 33, 35, 36, 37, 40, 41, 42, 45, 47, 49, and 50. The Worth of Statistics subscale is assumed to measure perception of the relevance of statistics. Higher scores on this subscale refer to more negative perception of the usefulness of statistics. The Interpretation Anxiety subscale is designed to measure anxiety experienced when trying to interpret statistical results. Interpretation Anxiety scale includes items 2, 5, 6, 7, 9, 11, 12, 14, 17, 18, and 20. Individuals who score high on this subscale indicate high anxiety in interpreting statistical results. The Test and Class Anxiety scale measures the anxiety experienced while taking statistics courses and/or examinations and includes items 1, 4, 8, 10, 13, 15, 21, and 22, with higher scores referring to higher anxiety. The Computation Self–Concept scale is related to a person's attitudes toward statistics and includes items 25, 31, 34, 38, 39, 48, and 51. Higher scores on this scale refer to more negative attitudes toward statistics. The Fear of Asking for Help subscale is assumed to assess anxiety experienced when a person attempts to ask for help in statistics-related problems. This scale includes four items: 3, 16, 19, and 23. Individuals who score higher in this subscale experience more anxiety in asking for help when they have problems in statistics. Finally, the Fear of Statistics Teachers subscale (items 30, 32, 43, 44, and 46) is supposed to be measuring students' perceptions of statistics teachers, with higher scores indicating more anxiety felt (Cruise et al., 1985).

Face validity, construct validity, and concurrent validity of the STARS were reported by Cruise et al. (1985). Five statistics professors and five doctoral students enrolled in statistics courses rated whether a particular item belonged to the scale or not. The coefficients of agreement scores ranged from .60 to 1.00, with a mean of .91, showing a strong face validity of the STARS.

STARS' construct validity was investigated through a principal component analysis with a varimax rotation. Results from 1,150 students revealed that factor loadings of these 6 scales varied between .48 and .86 (Cruise et al., 1985). By using data from 537 students, the STARS' concurrent validity was found by correlating the STARS with the MAS ($r = .76$, $p < .01$).

A Coefficient alpha reliability of the STARS scores ranged between .68 and .94, with a median of .88 (.94 for the Worth of Statistics, .87 for the Interpretation Anxiety, .69 for the Test and Class Anxiety, .88 for the Computational Self-Concept, .89 for the Fear of Asking for Help, and .80 for the Fear of Statistics Teachers). Onwuegbuzie (1993) reported a higher coefficient alpha reliability score (.96) by using 29 participants (.92 for the Worth of Statistics, .82 for the Interpretation Anxiety, .90 for the Test and Class Anxiety, .93 for the Computational Self-Concept, .83 for the Fear of Asking for Help, and .85 for the Fear of Statistics Teachers scales). In addition, 161 students took the STARS twice and five-week test-retest reliability was found to be ranging from .67 to .83, with a median of .76 (Cruise et al., 1985). Also, Onwuegbuzie (1998a) found that the reliability of the six scales ranged from .80 to .84, with a median score of .83.

Similarities Between Statistics Anxiety and Mathematics Anxiety

There may be two plausible reasons for perceiving statistics anxiety and mathematics anxiety as the same. The first reason may be because of "the frequent appearance of statistics courses within mathematics departments" (Gal & Ginsburg, 1994, p. 4), and the second reason may be because of statistically significant relationships between mathematics anxiety and statistics anxiety (Dew, Galassi, & Galassi, 1984).

Research has consistently demonstrated a moderate association between mathematics anxiety and statistics anxiety. For example, Birenbaum and Eylath (1994) studied the relationships between statistics anxiety and mathematics anxiety. They found that statistics anxiety was significantly related with mathematics anxiety ($r = .54$, $p < .001$). Inductive reasoning ability was the only variable that was significantly related to statistics anxiety ($r = -.26$, $p < .01$) but not related to mathematics anxiety ($r = -.10$, $p > .05$). Maysick (1984) reported positive relationships between statistics anxiety and mathematics test anxiety; however, he found negative relationships between statistics anxiety and both one's major of study and mathematical background. Most recently, Balo_lu (2001) found that statistics anxiety was significantly ($p < .01$) related to number anxiety ($r = .27$), mathematics course anxiety ($r = .48$), and mathematics exam anxiety ($r = .61$). He also found that mathematics anxiety was significantly ($p < .01$) related with worth of statistics ($r = .39$), interpretation anxiety ($r = .60$), statistics test and class anxiety ($r = .65$), computational self-concept ($r = .61$), fear of asking for help in statistical difficulties ($r = .37$), and fear of statistics teachers ($r = .34$).

Several other similarities exist between mathematics anxiety and statistics anxiety. First, both mathematics anxiety (e.g., Richardson & Suinn, 1972) and statistics anxiety (e.g., Cruise et al., 1985) are classified as situation-specific, content oriented, state anxieties. Also, mathematics anxiety (Sherard, 1981) and statistics anxiety (Zeidner, 1991) include emotional elements and the elements of worry. Second, the dimensions of statistics anxiety and mathematics anxiety show some resemblance. For example, even though mathematics anxiety was initially hypothesized as a unidimensional construct (Richardson & Suinn, 1972), it has later been found to be bidimensional (Alexander & Cobb, 1984; Plake & Parker, 1982) or multidimensional (Alexander & Martray, 1989; Kazelskis, 1998; Satake & Amato, 1995). On the contrary, statistics anxiety was initially proposed as a multidimensional construct (Cruise et al., 1985). Third, in anxiety literature, there seems to be an agreement regarding the classification of the antecedents of the two. Both mathematics anxiety (Byrd, 1982) and statistics anxiety (Onwuegbuzie, 1993) have similar dispositional, situational, and environmental antecedents. Finally, both mathematics anxiety and statistics anxiety have physiological, cognitive, psychological, and behavioral impacts on individuals (Fennema & Sherman, 1976; Onwuegbuzie et al., 1997).

Discussion and Suggestions

Reducing statistics anxiety is one of the main goals in statistics teaching. We believe that statistics anxiety can only be reduced after effective intervention strategies are developed and implemented. However, in order to be able to develop effective strategies, the nature of statistics anxiety should be studied. In this vein, most attempts have not focused on non-cognitive areas such as anxiety related to statistics. Moreover, there is lack of agreement among researchers as to what constitutes statistics anxiety and its relations with other related constructs.

It is noteworthy that studies that found statistics anxiety as a unidimensional or bidimensional construct have used the modified versions of mathematics anxiety instruments. Thus, the underlying construct in these studies was mathematics anxiety. Moreover, the psychometric properties of such “modified instruments” have not been adequately investigated. Therefore, a better investigation of the nature of statistics anxiety may be achieved by using assessment instruments specifically developed to measure statistics anxiety.

Studies that used original statistics anxiety instruments (i.e., the Statistical Anxiety Rating Scale-STARS) have found the nature of statistics anxiety to be different from mathematics anxiety (e.g., Cruise et al., 1985; Cruise & Wilkins, 1980; Onwuegbuzie, 1999a; Onwuegbuzie, DaRos, & Ryan, 1997). Studies that found statistics anxiety and mathematics anxiety to be related showed that, at the maximum, less than 50% (R^2 = .42) of the variance in statistics anxiety is explained by mathematics anxiety. This supports our suggestion that statistics anxiety may be a separate construct from mathematics anxiety; however, further differentiation is needed.

In summary, the review of the literature suggests that future correlational and factor analytical studies are necessary to empirically examine the relationship between measures of statistics anxiety and mathematics anxiety. An area of future research would be to use several mathematics anxiety and statistics anxiety scales either separately or within a single scale and provide a comparison. For example, the items of the statistical anxiety rating scale and mathematics anxiety rating scale can be completed by a group of students who are enrolled in a statistics or mathematics course and later responses can be subjected to an exploratory or/and a confirmatory factor analysis. This will show what aspects of statistics anxiety are similar to or different from mathematics anxiety.

References

Alexander, L., & Cobb, R. (1984). *Identification of the dimensions and predictions of mathematics anxiety among college students.* Paper presented at the meeting of the Mid-South Educational Research Association, New Orleans, LA.

Alexander, L., & Martray, C. (1989). The development of an abbreviated version of the Mathematics Anxiety Rating Scale. *Measurement and Evaluation in Counseling and Development, 22,* 143-150.

Auzmendi, E. (1991, April). *Factors related to attitudes toward statistics: A study with a Spanish sample.* Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL. (ERIC Document Reproduction Service No. ED333049)

Balo_lu, M. (2001). *An application of structural equation modeling techniques in the prediction of statistics anxiety among college students.* Unpublished doctoral dissertation, Texas A&M University-Commerce.

Benson, J. (1989). Structural components of statistical test anxiety in adults: an exploratory model. *Journal of Experimental Education, 57,* 247-261.

Benson, J., & Bandalos, D. L. (1989). Structural model of statistical test anxiety in adults. In R. L. Schwarzer, H. M. van der Ploeg, & C. D. Spielberger (Eds.), *Advances in test anxiety research: Vol. 6.* (pp. 137-154). Amsterdam/Lisse, The Netherlands: Swets & Zeitlinger; Berwyn, PA: Swets North America.

Berk, R. A., & Nanda, J. P. (1998). Effects of jocular instructional methods on attitudes, anxiety, and achievement in statistics courses. *International Journal of Humor Research, 11,* 383-409.

Betz, N. E. (1978). Prevalence, distribution, and correlates of math anxiety in college students. *Journal of Consulting Psychology, 25,* 151-157.

Birenbaum, M., & Eylath, S. (1994). Who is afraid of statistics? Correlates of statistics anxiety among students of educational sciences. *Educational Research, 36,* 93-98.

Buck, J. L. (1987). More on superiority of women in statistics achievement: A reply to Brooks. *Teaching of Psychology, 14* (1), 45-47.

Byrd, P. (1982). *A descriptive study of mathematics anxiety: Its nature and antecedents.* Unpublished doctoral dissertation, Indiana University.

Cruise, R. J., Cash, R. W., & Bolton, D. L. (1985, August). *Development and validation of an instrument to measure statistical anxiety.* Paper presented at the annual meeting of the American Statistical Association Statistics Education Section. Las Vegas, Nevada.

Cruise, R. J., & Wilkins, E. M. (1980). *STARS: Statistical Anxiety Rating Scale*. Unpublished manuscript, Andrews University, Berrien Springs, MI.

Demaria-Mitton, P. A. (1987). *Locus-of-control, gender and type of major as correlates to statistics anxiety in college students.* Unpublished doctoral dissertation, American University.

Dew, K. M. H., Galassi, J. P., & Galassi, M. D. (1984). Math anxiety: Relation with situational test anxiety, performance, physiological arousal, and math avoidance behavior. *Journal of Counseling Psychology, 31,* 580-583.

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman Mathematics Attitude Scale: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *JAS Catalog of Selected Documents in Psychology, 6*, 31.

Gal, I., & Ginsburg, L. (1994). The role of beliefs and attitudes in learning statistics: Towards an assessment framework. *Journal of Statistics Education, 2,* 1-54.

Holmes, P., & Turner, D. (1981). Teaching statistics to eleven-to-sixteen-year-olds: An account of some development work in England and Wales. *National Council of Teachers of Mathematics Yearbook.*

Johnson, D. E. (1999). An intuitive approach to teaching analysis of variance. In M. E. Ware & C. L. Brewer (Eds.), *Handbook for teaching statistics and research methods* (2nd ed.). New Jersey: Lawrence Erlbaum Associates, Publishers.

Kazelskis, R. (1998). Some dimensions of mathematics anxiety: A factor analysis across instruments. *Educational and Psychological Measurement, 58,* 623-633.

Maysick, D. J. (1984). *The relationship of self-concept, sex, age, major, anxiety, mathematics background and mathematics ability to the* *level of mathematics and statistical anxiety among college juniors.* Unpublished doctoral dissertation, Andrews University.

Murdock, M. (1982). Teaching to overcome statistics anxiety. *Proceedings of Statistical Education-American Statistical Association, 92-93.*

Onwuegbuzie, A. J. (1993). *The interaction of statistics test anxiety and examination condition in statistics achievement of post-baccalaureate non-statistics majors.* Unpublished doctoral dissertation, the University of South Carolina.

Onwuegbuzie, A. J. (1997a). Writing a research proposal: The role of library anxiety, statistics anxiety, and composition anxiety. *Library & Information Science Research 19,* 5-33.

Onwuegbuzie, A. J. (1997b). The teacher as researcher: The relationship between enrollment time and achievement in a research methodology course. *Reflection and Research, 3* (1), [On-Line] http://www.gonzaga.edu/rr/v3n1/tony.html.

Onwuegbuzie, A. J. (1998). Statistics anxiety: a function of learning style? *Research in the Schools, 5,* 43-52.

Onwuegbuzie, A. J. (1999a). *A synopsis of research related to statistics anxiety.* Unpublished manuscript.

Onwuegbuzie, A. J. (1999b). Differences between statistics anxiety and mathematics anxiety: Commentary received from personnel communication via e-mail [33 lines]. Available E-Mail: mailto:baloglu@hotmail.com Message: request for help.

Onwuegbuzie, A. J. (in press). Prevalence of statistics anxiety among graduate students. *Journal of Research in Education.*

Onwuegbuzie, A. J., DaRos, D., & Ryan, J. M. (1997). The components of statistics anxiety: a phenomenological study. *Focus on Learning Problems in Mathematics, 19* (4), 11-35.

Perney, J., & Ravid, R. (1990, April). *The relationship between attitudes toward statistics, math self-concept, test anxiety and graduate students' achievement in an introductory statistics course.* Paper presented at the meeting of the American Educational Research Association, Boston, MA.

Plake, B. S, & Parker, C. S. (1982). The development and validation of a revised version of the Mathematics Anxiety Rating Scale. *Educational and Psychological Measurement, 42,* 551-557.

Pretorius, T. B., & Norman, A. M. (1992). Psychometric data on the statistics anxiety scale for a sample of South African students. *Educational and Psychological Measurement, 52,* 933-937.

Richardson, F. C., & Suinn, R. M. (1972). The Mathematics Anxiety Rating Scale: Psychometric data. *Journal of Counseling Psychology, 19,* 551-554.

Richardson, F. C., & Woolfolk, R. L. (1980). Mathematics anxiety. In I. G. Sarason (Ed.), *Test anxiety: Theory, research, and applications*. Hillsdale, NJ: Erlbaum.

Satake, E., & Amato, P. P. (1995). Mathematics anxiety and achievement among Japanese elementary school students. *Educational and Psychological Measurement, 55,* 1000-1007.

Schau, C., Stevens, J., Dauphinee, T. L., & Del Vecchio, A. (1995). The development and validation of the Survey of Attitudes Toward statistics. *Educational & Psychological Measurement, 55,* 868-875.

Sherard, W. H. (1981). Math anxiety in the classroom. *The Clearing House, 55,* 106-110.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, California: Consulting Psychologists Press.

Wentzel, C. (1998). *A comparison of statistics anxiety and mathematics anxiety among graduate students in the social sciences.* Unpublished doctoral dissertation, University of Alberta.

Widmer, C. C., & Chavez, A. (1986). Helping students overcome statistics anxiety. *Educational Horizons, 64* (2), 69-72.

Wise, S. L. (1985). The development and validation of a scale measuring attitudes toward statistics. *Educational and Psychological Measurement, 45,* 401-405.

Yeger, G. G., & Wilson, F. R. (1986). *Ten suggestions on teaching research to counseling students*. Paper presented at the meeting of the North Central Association for Counselor Education and Supervision, Kansas City.

Zeidner, M. (1991). Statistics and mathematics anxiety in social science students: some interesting parallels. *British Journal of Educational Psychology, 61,* 319-328.

Zerbolio, D. J. (1999). A bag of tricks for teaching about sampling distributions. In M. E. Ware & C. L. Brewer (Eds.), *Handbook for teaching statistics and research methods*_(2nd ed.). New Jersey: Lawrence Erlbaum Associates, Publishers.