Relationship Between Graduate Students' Statistics Self-Efficacy, Statistics Anxiety, Attitude Toward Statistics, and Social Support

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Statistics plays an integral role in graduate programs. However, numerous intra- and interpersonal factors may lead to successful completion of needed coursework in this area. The authors examined the extent of the relationship between self-efficacy to learn statistics and statistics anxiety, attitude towards statistics, and social support of 166 graduate students enrolled in master's and doctoral programs within colleges of education. Results indicated that statistics anxiety and attitude towards statistics were statistically significant predictors of self-efficacy to learn statistics, yet social support was not a statistically significant predictor of self-efficacy. Insight into how this population responds to statistics courses and implications for educators as well as students are presented.

Keywords: graduate students, statistics, anxiety, self-efficacy, attitudes, social support

More graduate programs in various social science fields are requiring students to complete research methods including statistics courses or a blended combination thereof (Davis, 2003; Schau, Stevens, Dauphinee, & Del Vecchio, 1995). These course requirements pose a dilemma for educators and students because many students perceive statistics as difficult and unpleasant (Berk & Nanda, 1998). Some students can struggle in statistics courses as a related complication of this perception as well as other intrapersonal factors related to the course.

To investigate graduate students' experiences in statistics courses, researchers studied different avenues to understand what occurs with students so steps can be taken to improve learning as well as satisfaction in college statistics courses. For instance, researchers suggested non-cognitive factors such as motivation for further learning (Gal & Ginsburg, 1994; Finney & Schraw, 2003), statistics self-efficacy (Onwuegbuzie & Wilson, 2003), and attitude toward statistics (Araki & Schultz, 1995; Elmore, Lewis, & Bay, 1993; Waters, Martelli, Zakrajsek & Popovich, 1988; Wise, 1985) should be assessed and addressed with students. Finney and Schraw theorized that the difficulty students experience with statistics is not necessarily due to lack of intelligence or poor aptitude, but may be a result of the above mentioned factors. Bonilla (1997), Cohen and McKay (1984), and Solberg and Villarreal (1997) hypothesized that social support may act as a buffer against the development of these psychological manifestations.

The purpose of this study was to examine the various factors that have been introduced in previous research in one comprehensive study. The goal was to determine how graduate student self-efficacy to learn statistics is predicted by statistics anxiety, attitude toward statistics, and social support (Gall, Gall, & Borg, 2007). The overarching intent was to document graduate student self-efficacy to learn statistics and identify how certain variables influence statistics self-efficacy (Pan & Tang, 2005).

Self-Efficacy to Learn Statistics

In order to understand the implications of this research, an explanation of the key variables found in the literature review must first be discussed. Self-efficacy to learn statistics is the dependent variable in this study. Bandura (1977) originally defined general self-efficacy as one's judgments of his or her capabilities to organize and carry out courses of action required to attain specific types of performances. Bandura asserted that self-efficacy beliefs are manifested from four primary sources, which include the following: (a) personal accomplishments, (b) vicarious learning experiences, (c) verbal persuasion, and (d) emotional arousal. These primary sources lay the foundation for building the concept of self-efficacy to learn statistics. Finney and Schraw (2003) defined self-efficacy to learn statistics and developed an assessment to measure

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this phenomenon. Self-efficacy to learn statistics is an individual's confidence in his or her ability to successfully learn statistical skills necessary in a statistics course.

A large amount of information is available on self-efficacy related to academic performance (Lent, Brown, & Larkin, 1984, 1986; Pajares, 1996; Pajares & Miller, 1995; Zimmerman, 2000; Zimmerman, Bandura, & Martin-Pons, 1992). However, little is known specifically about self-efficacy to learn statistics. Finney and Schraw (2003) investigated whether self-efficacy to learn statistics is related to performance in a statistics course and whether self-efficacy to learn statistics increased during a 12-week introductory statistics course. One hundred and three undergraduate students from a large Midwestern university participated in the survey. Finney and Schraw reported a positive relationship between statistics self-efficacy and academic performance as well as an increase in self-efficacy to learn statistics over the duration of the course. Onwuegbuzie (2000) also reported students with the lowest levels of perceived competence had the highest levels of statistics anxiety. Additionally, Pajares and Miller (1995) documented an inverse relationship between self-efficacy and math anxiety.

Statistics Anxiety

Statistics anxiety is one of the three independent variables in this study. Researchers have documented a large amount of information on statistics anxiety over the years. For instance, there are multiple definitions of statistics anxiety available in the literature. Onwuegbuzie, DaRos, and Ryan (1997) defined statistics anxiety as "a state-anxiety reaction to any situation in which a student is confronted with statistics in any form and at any time" (p. 28). Cruise, Cash, and Bolton (1985) defined statistics anxiety as "the feelings of anxiety encountered when taking a statistics course or doing statistical analyses: that is, gathering, processing, and interpret[ing]" (p. 92). The latter is the definition utilized for this study.

We know that instructors of research and statistics courses often encounter students with high levels of statistics anxiety upon their arrival to class (Perney & Ravid, 1991). According to Onwuegbuzie, Slate, Paterson, Watson, and Schwartz (2000), 75% to 80% of graduate students in the social sciences appeared to experience high levels of statistics anxiety. Statistics anxiety was found to be higher among female and minority graduate students in comparison to their male and Caucasian counterparts (Onwuegbuzie, 1999; Zeidner, 1991).

Researchers identified three categories of variables—situational, dispositional, and environmental—that are related to statistics anxiety (Onwuegbuzie & Wilson, 2003). Situational antecedents are factors that surround the student, including previous statistics experiences (Sutarso, 1992). Researchers found a negative connection between the number of completed mathematics courses and statistics anxiety (Auzmendi, 1991; Robert & Saxe, 1982; Zeidner, 1991). Forte (1995) found minimal previous math experience, late introduction to quantitative analysis, anti-quantitative bias, lack of appropriation for the significance of analytical models, and lack of mental imagery were factors contributing to statistics anxiety among social work students.

Dispositional antecedents are intrapersonal factors students bring to the classroom (Onwuegbuzie & Daly, 1999), which includes issues such as perfectionism and perception of abilities at developmental stages in life (Pan & Tang, 2004). Walsh and Ugumba-Agwunobi (2002) found evaluation concern, fear of failure, and perfectionism provoked statistics anxiety. Environmental antecedents are interpersonal factors related to the classroom experience (Onwuegbuzie & Daly, 1999), which can include the student's experiences with the professor. Tomazie and Katz (1988) reported previous experiences in statistics courses have influenced learning in a current course. Moreover, the environmental antecedent has the least research available in the literature.

Attitude Toward Statistics

Attitude toward statistics is the second independent variable in this study. Attitude towards statistics is defined in this study as a combination of a students' attitude toward the use of statistics in their field of study and the students' attitudes towards the statistics course (Cashin & Elmore, 1997; Wise, 1985). Researchers explored this area; however, there are many gaps left to fulfill. Gal and Gingsburg (1994) reported students often enter statistics courses with negative views or later develop negative feelings regarding the subject matter of statistics. Researchers found no statistically significant differences

among females' and males' attitudes towards statistics (Araki & Schultz, 1995; Cashin & Elmore, 2005; Harvey, Plake, & Wise, 1985). However, conflictingly, Waters et al. (1988) and Roberts and Saxe (1982) found male students had more positive attitudes towards statistics than female students.

According to Perney and Ravid (1991), statistics courses are viewed by most college students as a road block to obtaining their degree. Students often delay taking their statistic courses until the end of their program. Researchers found students' negative attitudes toward statistics is an influencing factor in low student performance in statistics courses (Araki & Schultz, 1995; Elmore et al., 1993; Harvey et al., 1985; Schulz & Koshino, 1998; Robert & Saxe, 1982; Waters et al., 1988; Wise, 1985).

Perceived Social Support

Perceived social support is the final independent variable in this study. Perceived social support for this study is defined as the level of support an individual self identifies as received from friends, family, and significant others (Zimet, Dahlem, Zimet, & Farley, 1988). This variable is influential in this study in terms of the potential buffering effect it may have on the other independent variables, statistics anxiety and attitude towards statistics.

According to Bonilla (1997), social support acts as a buffer to dysfunctional thoughts or attitudes. In 1985, Cohen and Wills investigated the process through which social support has a beneficial effect on well-being. The buffering model maintains that support is related to well-being primarily for persons under stress. Cohen and Wills identified four support resources, which include the following: (a) esteem support such as the person is valued and accepted, (b) informational support, (c) social companionship such as engaging in leisurely activities with others, and (d) instrumental support such as an individual providing a person with financial aid, material resources, or need-based services.

Solberg and Villarreal (1997) conducted a study to explore the interactions between social support and physical as well as psychological distress of Latino college students. The authors reported social support moderated the distress. Specifically, the Latino students who believed social support was available had lower psychological distress than students who believed that social support was less accessible.

Research Questions

Six research questions were included in this study. The first four focus on descriptive information from our sample and include the following: (a) what is the graduate student self-efficacy level, (b) what is the graduate student statistics anxiety level, (c) what is the graduate student attitude toward statistics, and (d) what is the graduate student level of perceived social support? The predominate research question driving this study is, what is the extent of the relationship, if any, between graduate students' self-efficacy to learn statistics and statistics anxiety, attitude towards statistics, and social support? A supplemental research question was, what is the influence of social support on statistics anxiety and attitude towards statistics?

Method

Participants

Participants were recruited by the researcher emailing faculty members of doctoral and master's programs within colleges of education at 250 universities within the United States. The faculty members were asked to forward information about the opportunity to participate in the study to their students. One hundred sixty-six graduate students within colleges of education representing 27 states fully completed the online survey within the 8-week data collection timeframe. An a priori power analysis was conducted considering involvement of three predictors in the multiple regression equation and estimating a moderate effect size based on similar studies. It was determined that 119 participants are needed to achieve adequate power in the study (Faul, 2006); thus, an appropriate sample size was achieved to obtain adequate power in the analysis (Gall et al., 2007).

The sample was predominately female ($N = 136$, 81.9%) compared to males ($N = 30$, 18.1%). Participants' age ranged

from 21 to 71 with 34.4 as the mean age. The cultural makeup of the sample consisted of 4 Native American (2.4%), 4 Asian/Pacific Islander (2.4%), 24 African American (14.5%), 124 Caucasian (74.7%), and 10 Latino participants (6%).

The academic level of the participants was close to evenly split with 92 master's students (55.4%) and 74 doctoral students (44.5%). The majority of the sample ($N = 144$, 86.7%) were enrolled in counseling or related educational programs such as mental health counseling, school counseling, rehabilitation counseling, student affairs, and counselor education and supervision. Twenty-two (13.3%) participants were enrolled in education graduate programs such as educational leadership, curriculum and instruction, and educational technology. One hundred thirty-six participants (81.9%) were enrolled in programs that were accredited by at least one accreditation body appropriate to their program.

Participants had different backgrounds in terms of taking statistics courses. The mean number of completed graduate statistics classes at the time of participating in the study was 1.63 classes for the sample. The range of courses was 0 to 6, and the mode was 0 classes with 45 participants (27.1%) not having completed a single graduate level statistics course. Of the 121 who completed a statistics course previously, the mean final grade was 89.34% with the lowest grade earned reported as 70%.

Instruments

A demographic questionnaire was used to collect information related to participants' personal characteristics as well as previous experiences with graduate statistics classes. The Self-Efficacy to Learn Statistics (SELS) scale was used to measure the dependent variable (Finney & Schraw, 2003). The SELS measures confidence in one's ability to learn necessary statistics while in a statistics course in order to successfully complete 14 specific tasks using a 1 (no confidence at all) to a 6 (complete confidence) response scale. Only a total score is obtained from the instrument. Internal consistency reliability was reported as .975 Cronbach's alpha. Validity evidence of SELS to other variables was reported. The SELS was positively correlated with the Math Self-Efficacy scale and negatively correlated to the general and statistics Test Anxiety Inventory subscale providing evidence of concurrent validity. The norm group for the instrument was a total of 154 college students enrolled in an introductory statistical methods course.

The Statistics Anxiety Rating Scale (STAR) was used to measure the independent variable statistics anxiety (Baloglu, 2002; Cruise &Wilkins, 1980). The assessment is a 51-item Likert scale ranging from 1 (no anxiety) to 5 (very much anxiety) and measures anxiety in two parts. The first part includes 23 statements related to statistics anxiety and the second part has 28 items related to dealing with statistics. A total score as well as six subscores including the following are generated with this instrument: Worth of Statistics, Interpretation Anxiety, Test and Class Anxiety, Computation Self-Concept, Fear of Asking for Help, and Fear of Statistics Teacher. Reliability for each of the subscales ranged between .68 to .94 with a median of .88 (Worth of Statistics .94, Interpretation Anxiety .87, Test and Class Anxiety .69, Computational Self-Concept .88, Fear of Asking for Help .89, and Fear of Statistics Teachers .80). Validity evidence of STARS to other variables was reported. The STARS had a strong correlation ($r = .76$) to the Math Anxiety Scale (Roberts & Bilderback, 1980). The instrument was normed with 1,150 university students enrolled in statistics courses.

The independent variable, attitude toward statistics, was measured by the Attitude Toward Statistics (ATS) scale (Schultz & Koshino, 1998). This is a 29 item, 5-point Likert scale ranging from strongly disagree to strongly agree. A total score and two subscale scores, Attitudes Toward the Field and Attitudes Toward the Course, are obtained from the instrument. Both subscales were reported as reliable with Cronbach's alpha at .92 for Attitudes Toward the Field and .91 for Attitudes Toward the Course (Wise, 1985). The ATS was reported to have strong concurrent validity with the Statistics Attitude Survey. The norm group consisted of 162 university students enrolled in an introductory educational statistics course.

The third independent variable, social support, was measured by the Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet, Powell, Farley, Werkman, & Berkoff, 1990). The instrument has 12 items and utilized a 7-point Likert scale ranging from very strongly disagree to very strongly agree. A total score and three subscale scores (support from significant others, support from family, and support from friends) were obtained. The instrument was reported as reliable with Cronbach's alpha coefficients reported as .85 to .91 for the three subscales. Test-retest values ranges from .72 to .85. Zimet et al. reported significant correlations between the MSPSS subscales and the Depression and Anxiety subscales of the Hopkins Symptom Checklist as evidence of construct validity for their instrument. The norm group consisted for 275 university students at Duke University.

Data Analysis

A simultaneous multiple regression was analyzed to determine the extent of the relationship between graduate students' self-efficacy to learn statistics and statistics anxiety, attitude towards statistics, and social support. Alpha level was set at .05 for the analysis and semipartial correlation coefficients were assessed for practical significance. The multiple regression was repeated, removing social support from the analysis to explore any moderating effects of social support on the model.

Results

Descriptive statistics of the sample data are displayed in Table 1 and sample scores for the assessments with a comparison to the maximum and minimum scores for the instruments are included in Table 2. Self-efficacy to learn statistics scores were normally distributed (SW(173) = .986, p = .076) and the box plot for the criterion variable confirmed normality as well. Standardized residuals also were normally distributed (SW(173) = .988, p = .159) and the box plot for the standardized residuals and scatterplots confirmed normality of the error variance or homoscedasticity. Scatterplots were analyzed for linearity, and it was determined no curvilinear relationships between the criterion variable and predictor variables were evident. Statistics anxiety and attitude towards statistics were highly correlated (-0.83), indicating multicollinearity.

Table 1

Descriptive Statistics, Predictor Variable Correlations, Multiple Regression Results

	M	SD	Self-Efficacy	Statistics Anxiety	Attitude Toward Stats	Social Support	B	SE	Beta	t	p
Self-Efficacy	49.73	18.97	1	-0.679	0.708	-0.023	-	-	-	-	-
Statistics Anxiety	119.95	35.83	-	1	-0.832	0.006	-0.15	0.051	-0.292	-3	0.003
Attitude Toward Stats	106.73	18.91	-	-	1	0.017	0.467	0.098	0.466	4.785	0.001
Social Support	5.69	1.04	-	-	-	1	-0.53	0.981	0.981	-0.54	0.593

Table 2

Assessment Scores

Scale	M	SD	Min	Max	Lowest Possible	Highest Possible
Statistics Self-Efficacy[a]	49.73	18.97	14	84	14	84
Statistics Anxiety[b]	119.95	35.83	56	201	51	255
Worth of Statistics[c]	32.2	12.68	16	75	16	80
Interpretation Anxiety[c]	26.99	9.31	11	53	11	55
Test and Class Anxiety[b]	24.48	8.12	8	40	8	40
Computation Self-Concept[c]	15.42	6.32	7	30	7	35
Fear of Asking for Help[b]	9.81	3.35	4	20	4	20
Fear of Statistics Teachers[b]	11.05	4.42	5	25	5	25
Attitude Toward Statistics[d]	106.73	18.91	38	143	29	145
Attitude Toward the Field[d]	78.4	11.96	29	100	20	100
Attitude Toward the Class[d]	28.33	8.79	9	45	9	45

Perceived Social Support[e]	5.69	1.04	1	7	1	7	
Significant Other Support[e]	5.83	1.14	1	7	1	7	
Family Support[e]	5.41	1.48	1	7	1	7	
Friend Support[e]	5.67	1.03	1	7	1	7	

[a]Lower scores indicate low self-efficacy.
[b]Lower scores indicate less reported anxiety.
[c]Lower scores indicate perceiving statistics as less useful.
[d]Lower scores indicate negative attitude.
[e]Lower scores indicate less support.

There was a statistically significant relationship between self-efficacy to learn statistics and statistics anxiety, attitude towards statistics, and social support: $F(3, 162) = 60.489$, $p < .001$. A moderate effect size was noted with 52.8% of the variance accounted for in the model, $R^2 = .528$. Statistics anxiety and attitude towards statistics were statistically significant predictors of self-efficacy to learn statistics and accounted for 3% and 7% of the variance, respectively. Social support was not a statistically significant predictor of self-efficacy to learn statistics and accounted for .1% of the variance. When social support was removed from the analysis, there was no change in statistical or practical significance.

Discussion

This study sought to explore the relationships of graduate students' self-efficacy to learn statistics, statistical anxiety, attitudes towards statistics, and social support. The scores from the various instruments identifying each of the aforementioned variables produced both negative and positive correlations among each other. A statistically significant relationship was found among self-efficacy and statistical anxiety, attitudes towards statistics and social support indicating the importance of the graduate students' belief in their competence of facing the challenges of learning statistics. However, there was no change in the relationship when social support was removed from the analysis; thus, it was not a contributing variable. Statistics self-efficacy scores from participants indicated moderate responses which mirrored the prior studies involving undergraduate students (Pajares, 1996; Zimmerman, 2000). As this was the first study that investigated graduate students, these results create a path for future research.

There was a negative correlation between self-efficacy to learn statistics and statistical anxiety of the graduate students. The negative correlation is consistent with Onwuegbuzie's (2000) findings. Participants reported the lowest responses in the Fear of Asking for Help and Worth of Statistics subscales, signaling graduate students reluctance for asking for assistance from the professor and peers as well as a low belief in the applicability and purpose of statistics. Overall, these results and the negative correlation between self-efficacy and anxiety seem to depict a kind of self-fulfilling prophecy that graduate students assume when faced with taking statistics which is similar to Perney and Ravid's (1991) report.

A positive correlation was found between self-efficacy to learn statistics and attitudes towards statistics. This results indicated that the better the attitude of the graduate students towards statistics, the higher self-efficacy beliefs to learn the subject. Results indicated a more moderate response to attitudes not found in other studies where students were coming in with a negative attitude or were developing negative attitudes towards the end of the course (Gal & Gingsburg, 1994). It may be considered that graduate students in this study were neutral in their attitudes towards learning statistics without extreme reactions.

Participants reported a high level of social support, which indicates that most of the graduate students believed they had adequate support. The sample perceived social support as an influential factor in their lives, which is similar to most college student population reports (Solberg & Villarreal, 1997). However, social support was not a statistically significant predictor of self-efficacy to learn statistics. Also, when this variable was removed from the multiple regression analysis, there was no statistical or practical change in the regression. The insignificant result implies that social support was present for students, but it did not interact as a buffer between variables and possibly decrease anxiety or increase positive attitudes as indicated by Bonilla (1997), Cohen and McKay (1984), and Solberg and Villarreal (1997). Thus, social support may possibly help one cope but not necessarily remove the problem, change attitudes, or change thinking.

Multicollinearity between statistics anxiety and attitude toward statistics suggests an interrelationship between the two variables (Gall et al., 2007). Both variables may be measuring the relatively same characteristic; thus, neither variable may have brought something completely new to the analysis. It is interesting to note that statistics anxiety and attitude toward statistics as measured by the instruments in this particular study may be focusing on the same phenomenon.

Significance

There were multiple benefits of this study. First, this study contributed to counselor education and student support services by increasing our knowledge of self-efficacy to learn statistics as experienced by graduate students. It also is significant because it documented students' experiences, which may act as a spring board for (a) future research, (b) implementing support interventions to increase statistics self-efficacy or success in statistics courses, and (c) helping students prepare for intrapersonal challenges that might impact their success in statistics. Each of these improvements are beneficial because they may increase graduate student self-efficacy and success in statistics courses as well as increase the incorporation of statistics into professional work after graduation.

Recommendations for Counselor Educators

Decreasing anxiety among graduate students is vital to developing high levels of self-efficacy towards statistics. Implementing numerous opportunities for students to engage in research throughout their graduate studies allows for opportunities to be exposed to statistics, thus increasing students' confidence when faced with taking a statistics course. Also, inserting research and statistics into the curriculum of every graduate course exposes graduate students to the terminology and the function statistics play in their development as professionals. Possible ways to decrease statistical anxiety are through language and experience. Allowing graduate students to learn what is being said in a statistics course through weekly vocabulary tests can be one example of decreasing their anxiety. Also, getting the students involved with their own research throughout their course of study will help in promoting statistics mastery.

Improving attitudes towards statistics can help graduate students reframe their negative views towards the course. Helping graduate students to choose a positive view, explore origins or core of negative attitudes, and to appreciate the usefulness of statistics in their profession are good starting points for developing salient attitudes towards the subject. Counselor educators in a position to help graduate students confront negative attitudes, model positive attitudes and enthusiasm for statistics, and place a high value on statistics through verbal support and high expectations of research and statistics for students in graduate programs. The professor teaching statistics can play a key role in positively impacting their students' attitude toward the subject. Injecting humor, displaying empathy, providing a safe space for students to talk about their challenges, and celebrating their small successes can be tools in combating negative attitudes. Anecdotal stories of statistics professors engaging in statistical rap songs have been reported to successfully alleviate attitudes towards the subject as well as provide a positive environment to engage in learning.

Limitations of the Study

There were limitations to this study. For instance, graduate students in counseling and education related programs were recruited for the study; thus, due to the general nature of the population, there were a disproportionate number of females and Caucasian students in the sample. As a result, a diverse sample was not obtained. However, a representative sample was acquired. Also, there were four scales for participants to answer in the study, therefore putting a time constraint burden on students to finish the instruments. Finally, these instruments were self-reporting, which can promote bias in how the graduate students answered (Gall et al., 2007).

Suggestions for Future Research

Future research should expand investigations into statistics self-efficacy predictor variables that include number of statistics courses taken, previous statistics experience, and broad demographics of graduate students to include more participants representing the various races and ethnicities, marital status, and life experiences. Longitudinal studies to monitor how statistics self-efficacy changes for graduate students over time would provide a snapshot of the development

of attitudes throughout their graduate study tenure. Experimental designs to assess classroom and counseling based intervention effectiveness in reducing anxiety and improving attitudes should be conducted to improve the reliability of students learning statistics and influence the participation of conducting their own research for the betterment of the counseling profession. Finally, qualitative studies need to be conducted to better capture students' experiences in statistics classes.

Conclusion

Researching predictors of graduate students' statistical self-efficacy beliefs is important to identifying possible barriers to professional growth and development. Exploring how statistical self-efficacy beliefs relate to predicting future academic expectations, performance, effort, persistence, and course selection (Pajares, 1996; Zimmerman, 2000) also is important to explore as a means of promoting professional development (Lent et al., 1984, 1986).

Graduate students who believed they were incapable of achieving success in a statistics course demonstrated higher levels of anxiety (Onwuegbuzie, 2000). This anxiety was pervasive among the 75% to 80% of graduate students in the social sciences profession in previous research studies (Onwuegbuzie et al., 2000), as well as to the 53% of the graduate students in this study. Additionally, graduate students hold off from taking a statistics course due to their negative attitudes towards the subject matter (Gal & Gingsburg, 1994). Teaching graduate students how to reduce their anxiety and improve their attitude will likely enhance their value of statistics and further encourage their professional development in the counseling profession.

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