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I, Haley Keller, hereby submit this original work as part of the requirements for the degree of Master of Science in Genetic Counseling.

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Student's name: **Haley Keller**

This work and its defense approved by:

Committee chair: Carrie Atzinger, M.S., C.G.C.

Committee member: Hua He, M.S.

Committee member: Katherine Healy, M.S

Committee member: Geoffrey Yager, Ph.D.

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**Further validation of the Genetic Counseling Self-Efficacy Scale (GCSES):
its relationship with personality characteristics.**

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Haley Keller

B.S. University of Dayton

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Committee Chair:

Carrie Atzinger, MS, LGC

Committee Members:

Katie Wusik, MS, LGC

Hua He, MS

Geoffrey Yager, PhD

Abstract

The purpose of the current study was to provide further validation of the Genetic Counseling Self-Efficacy Scale (GCSES) by determining the relationship between genetic counseling self-efficacy, personality characteristics, and performance on the American Board of Genetic Counselors (ABGC) board certification exam. In this study, genetic counselors completed a questionnaire that included the GCSES, work locus of control scale, trait subscale of the State Trait Anxiety Inventory (STAI), and questions related to board exam performance. Increased genetic counseling self-efficacy was found to be positively related to internal work locus of control and negatively related to higher trait anxiety. In addition, genetic counselors' years of experience and the genetic counselors' current position (direct patient care vs non-direct patient care) were found to be significantly related to factor scores on the GCSES. Findings from the current study (a) provide additional validation for the GCSES, (b) serve to add clarity to the relationships between genetic counseling self-efficacy, and personality characteristics, and (c) promote genetic counselor professional development. Further studies characterizing the relationship between genetic counseling self-efficacy and genetic counseling competencies may aid in better understanding the differences and/or similarities between genetic counseling self-efficacy and genetic counselor competency.

Keywords: *self-efficacy, genetic counseling self-efficacy scale (GCSES), personality, locus of control, anxiety*

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Introduction

The Genetic Counseling Self-Efficacy Scale (GCSES) is a newly developed scale specific to genetic counseling, which has the potential to be used as an outcome in genetic counselor training and as a tool in genetic counselor professional development (Caldwell, Wusik, He, Yager, & Atzinger, 2018a). Self-efficacy involves the perception of one's ability to perform an action in a specified situation (Bandura, 1982). Self-efficacy in other fields has shown to be related to locus of control and anxiety, but we do not know how the GCSES performs with these personality characteristics (Barbee & Combs, 2003; Harper, 2008; Judge & Bono, 2001). Thus, determining if a similar relationship exists between genetic counseling self-efficacy and these personality characteristics would provide further evidence of the validity and application of the GCSES. In addition, a better understanding of work and personality factors that are related to GCSES scores could facilitate the use of the GCSES in the area of professional development for genetic counselors.

Self-Efficacy

The theory of self-efficacy is described as the perception of an individual's ability to perform a select set of skills or competencies in a particular situation. An individual's assessments of his/her own capabilities are a determinant of behavioral, cognitive process, and emotional responses to difficult situations (Bandura, 1982). Perceived self-efficacy influences one's choices, effort expenditures, and emotional reactions: when faced with difficulties, an individual with a low perceived self-efficacy will deem their capabilities inadequate and will reduce their efforts to overcome the challenge. In contrast, an individual with a high perceived self-efficacy will increase attention and energy towards the demands presented. Bandura's

theory of self-efficacy consists of two elements: efficacy expectations and outcome expectations. *Efficacy* expectations refer to an individual's beliefs about their skills for effectively completing tasks. *Outcome* expectations refer to an individual's beliefs regarding the likelihood their actions will lead to a specified outcome. Successful performance of a particular behavior requires not only knowledge and skill to perform the behavior, but also confidence that one has the ability to perform the action (i.e., efficacy expectations), and expectations that certain behaviors will lead to the specified outcome (i.e., outcome expectations) (Bandura, 1977, 1982; Finley, Veatch, MacFarlane, LeRoy, & Callahan, 2016). However, it is important to note an individual's self-efficacy expectations may not always be predictive of skill or competence (Bandura, 1986).

Self-efficacy has been extensively studied in many different fields including fields with similarities to aspects of genetic counseling. In a cross-sectional study consisting of 138 counseling graduate students and professional psychologists, a positive correlation was found between self-efficacy, as measured by the Counselor Self-Efficacy Scale (CSES), professional training ($r = .62$) and years of experience ($r = .55$) (Melchert, Hays, Wiljanen, & Kolocek, 1996). An additional cross-sectional study found that of 116 counseling trainees, those with more completed coursework and internship hours reported increased levels of self-efficacy, measured by a Self-Efficacy Inventory (Tang et al., 2004). Furthermore, a longitudinal study of 179 master's-level counseling graduate students supported Bandura's theory of self-efficacy, such that the students' past experiences and participation in related counseling tasks assisted the students to grow more confident in achieving and completing work-related tasks (Mullen, Uwamahoro, Blount, & Lambie, 2015). Researchers have postulated that in an academic

setting, self-efficacy beliefs are associated with motivation, other self-beliefs such as self-concept, and academic choices, changes, and performances (Pajares, 1996). A cross-sectional study including 460 secondary school teachers, found that those with higher levels of self-efficacy perceived work demands more as challenges, rather than hindrances, and consequently perceived more positive experiences through work (Ventura, M., Salanova, M., Llorens, S., 2015).

Locus of Control

Locus of control and anxiety are two personality characteristics that have been identified as independent traits associated with an individual's self-efficacy (Judge & Bono, 2001; Larson & Daniels, 1998). Locus of control (LOC) is the way in which individuals believe their achievements in life are controlled by their own actions (Rotter, 1966). Individuals can be distinguished between having an *internal* or *external* LOC. A person with an *internal* LOC is one who credits their own personal efforts and behavior as controlling their success. Whereas a person with an *external* LOC is one who credits outside forces, such as luck or chance in the environment, as controlling their fate (Rotter, 1966; Spector, 1982). Locus of control is not a static personality characteristic and can change throughout an individual's lifetime. It should be noted that self-efficacy and locus of control represent different concepts: self-efficacy involves beliefs about whether an individual can perform certain tasks whereas LOC addresses beliefs about whether an individual's actions (internality) or other forces (externality) impact an outcome or reward (Bandura, 1997; Spector 1988).

LOC has been shown to influence individuals' perceptions of their work environment, job performance and career success, and interpersonal relationships. For example, individuals

with internal LOC may view their work environment more positively and may have better interpersonal relationships with coworkers, whereas those with external LOC may view their work environment more negatively and may have more difficult relationships with coworkers (Lefcourt, Martin, Fick & Saleh, 1985; Wang, Bowling, & Eschleman, 2010). Individuals with an internal LOC have been found to have increased job performance and job satisfaction; thus, LOC may impact an individual's behavior at work (Organ & Greene, 1974; Spector, 1982). A cross-sectional study including 191 full-time, non-self-employed United States workers in varying occupations (e.g., healthcare, education, finance) found that interpersonal conflict and counterproductive behavior, such as wasting time and/or materials, by employees is positively associated ($r=0.33$, $p<0.01$) with an external LOC, measured by the work LOC scale (Sprung & Jex, 2012). A longitudinal-intervention study with 67 Belgian physicians providing care for patients with cancer showed that physicians with an internal LOC, measured by Rotter's Internal-External (I-E) scale, demonstrated greater communication skills, such as open directive questions ($p = 0.004$), than physicians with an external LOC (Libert et al., 2007). The physicians with an internal LOC were thought to facilitate better communication because the physicians believed they controlled their communication with the patients (Libert et al., 2007). Internal LOC is also believed to generate better well-being, due to the perception of control having a psychological benefit in and of itself, without the actual occurrence of control (Thomas, Sorensen, & Eby, 2006).

A meta-analytic study, through the PsychInfo database between the years 1967-1997, of employed adults, in multiple different fields, found a positive relationship exists between generalized self-efficacy and internal LOC (Judge & Bono, 2001). Judge and Bono (2001) also

determined that self-evaluation traits, including self-efficacy and locus of control, are predictors of, and correlate positively with, both job satisfaction (mean $\rho = 0.45$ for generalized self-efficacy; 0.32 for LOC) and job performance (mean $\rho = 0.23$ for generalized self-efficacy; 0.22 for LOC) (Judge & Bono, 2001). Individuals with an internal LOC have been found to display “greater personal career effectiveness, exert greater effort, and perform better on the job” (Spector, 1982. p. 489). Furthermore, a quantitative study with 50 clinical psychology graduate students found a positive relationship between internal LOC, as measured by work locus of control scale, and increased counseling self-efficacy, as measured by Counseling Activity Self-Efficacy Scale ($r = 0.41$) (Harper, 2008; Lent, Hill, & Hoffman, 2003).

LOC has previously been studied among genetic counselors (GCs) in a cross-sectional, correlational study to investigate whether scores on the Rotter I-E scale influenced compassion fatigue risk, as measured by the Professional Quality of Life Scale (Injeyan et al., 2011). Fifty-five percent of the 214 GCs had an internal LOC and it was suggested that GCs with an internal LOC are more likely to have internally based optimism, due to a belief in their own perceived control capabilities rather than belief in good luck (Injeyan et al., 2011). However, currently no study has directly investigated whether an association exists between LOC and genetic counseling self-efficacy within the genetic counseling profession.

Anxiety

Another personality characteristic that has been associated with self-efficacy is anxiety. Anxiety is a common mood disorder and genetic counselors have been shown to have a prevalence of mild anxiety twice that of the prevalence of anxiety in the general population (Shipley, Koller, Quaid, Weaver, & Dickerson, 2013). More specifically, genetic counselors, and

genetic counseling students, have high levels of trait anxiety (Jungbluth, Macfarlane, Veach, & Leroy, 2011; Lee, Veach, Macfarlane, & Leroy, 2015). Trait anxiety is described as a measure of “anxiety proneness,” whereas state anxiety is described as a measure of an individual’s current, or temporary, state of anxiety (Julian, 2011).

A cross-sectional research study demonstrated a relationship between 113 university level counseling students’ level of pre-practicum service-learning training, self-efficacy, and anxiety, such that increased self-efficacy and increased training, independently, had a negative correlation with state anxiety (Barbee & Combs, 2003). Counseling self-efficacy (CSE) has been found to negatively correlate with trait and state anxiety (Larson & Daniels, 1998; Larson et al., 1992). Additionally, individuals with higher CSE scores are more likely to view their anxiety as a challenge, rather than a hindrance (Larson & Daniels, 1998). Although studies exist that investigate the relationship between genetic counselors and anxiety, there are no studies that have investigated the relationship between genetic counseling self-efficacy and anxiety.

The Genetic Counseling Self-Efficacy Scale

The items on the GCSES were developed from the Accreditation Council for Genetic Counseling (ACGC) Practice-Based competencies (PBCs) for genetic counselors and from Bandura’s self-efficacy theory (Caldwell et al., 2018a). The PBCs are the minimum knowledge, skills, and abilities ACGC outlines as necessary for successful practice as a genetic counselor (ACGC, 2015). Accredited genetic counseling graduate programs are required to ensure that graduates of their programs are competent in the PBCs. Items on the GCSES were adapted from the PBCs in all four domains: (a) Genetics Expertise and Analysis, (b) Interpersonal,

Psychosocial and Counseling Skills, (c) Education, and (d) Professional Development and Practice (ACGC, 2015; Caldwell et al., 2018a).

A pilot study of the GCSES determined that the scale is able to distinguish between the self-efficacy of genetic counseling students and practicing genetic counselors, therefore suggesting it is an effective tool to distinguish between self-efficacy of individuals with differing levels of experience (Caldwell et al., 2018a). Additionally, GC students' GCSES scores in the beginning of their second year of graduate training were highest for more basic skills, such as information gathering and genetic counseling process, and were lowest for complex genetic counseling skills. Owens-Thomas et al. surveyed 115 genetic counseling students at the end of their second year of graduate training and demonstrated that GC student self-efficacy was positively associated with the number of core cases accumulated during training (Owens-Thomas et al., 2018).

Caldwell et al. found that the genetic counseling student's perceived self-efficacy of certain genetic counseling tasks was related to the working alliance, which is the relationship between supervisor and student that facilitates the student's learning (Caldwell, Wusik, He, Yager, & Atzinger, 2018b; Efstation, Patton, & Kardash, 1990).

Study Purpose

The current study aimed to provide further validation of the GCSES and to describe the relationship between GCSES scores and genetic counselor personality characteristics that have previously been associated with self-efficacy in other fields, including work locus of control and trait anxiety. In addition, the current study aimed to determine if there is a relationship between genetic counseling self-efficacy and another outcome measure, board certification

exam performance. In addition, genetic counselors must take the ABGC Board Certification exam to become certified genetic counselors after graduation. ABGC board certification is tied to GC licensure and genetic counselors' ability to practice clinically in many states (Hampel et al., 2009). Understanding these relationships may allow for further validation of the GCSES and may promote genetic counselor professional development. Further, we aimed to look at whether characteristics of a genetic counselor's position, such as whether it is in direct patient care, are related to self-efficacy with clinical skills. Determining the relatedness between genetic counselor work setting and personality characteristics with self-efficacy and board exam performance may provide genetic counselors with important information for self-reflective practice.

Methods

The current study was approved by the Cincinnati Children's Hospital Medical Center Institutional Review Board (Study #2018-1703).

Participants and Procedures

The target population for the study was genetic counselors who graduated from an ACGC accredited genetic counseling program in the United States or Canada. An invitation to participate in the survey was sent to members of the National Society of Genetic Counselors (NSGC) through the NSGC student research listserv. The first invitation to participate was distributed on September 24, 2018. A reminder email was sent to the listserv four weeks after the initial invitation. The survey was closed on November 2, 2018.

Instrumentation

The survey was administered online through SurveyMonkey. The survey consisted of 5 sections: (a) demographics, (b) Genetic Counseling Self-Efficacy Scale, (c) Work Locus of Control Scale, (d) State Trait Anxiety Inventory trait subscale, and (e) questions related to American Board of Genetic Counseling (ABGC) certification examination performance for individuals who had taken the examination within a specified time frame (January 2016 – August 2018).

Demographics/Specialty Area. Demographic questions included: age, gender, race, ethnicity, years since graduation from accredited genetic counseling program, whether the individual had ever worked in a direct patient care position, and identification of the individual's current position (i.e., in direct patient care, *not* in direct patient care, or involved in both). Participants who answered yes to ever working in a direct patient care position were then asked about total whole years in direct patient care position and primary area of practice in most recent direct patient care position. Primary areas of practice included: cancer, prenatal/preconception, general genetics (pediatrics or adult), specialty disease (pediatrics or adult), or other.

Genetic Counseling Self-Efficacy Scale (GCSES). Genetic counseling self-efficacy was measured by scores on the factor subscales of the GCSES. There are six factor subscales on the GCSES: (1) Complex Skills, (2) Communication, (3) Genetic Testing, (4) Basic Psychosocial Skills, (5) Genetic Counseling Process, and (6) Information Gathering (Caldwell et al., 2018a). For each question on the GCSES, participants were asked to: "rate how certain you are that you can independently perform this competency today in a genetic counseling session". Example questions for each factor subscale includes: (1) Complex Skills – "Respond to client-counselor relationship dynamics, such as transference and countertransference", (2) Communication –

“Communicate relevant genetic information to a client to help them better understand certain conditions”, (3) Genetic Testing – “Select the most appropriate laboratory and genetic/genomic test for the given clinical situation”, (4) Basic Psychosocial Skills – “Respond with empathy to client’s emotions and concerns”, (5) Genetic Counseling Process – “Explain the genetic counseling process to a client”, and (6) Information Gathering – “Formulate targeted, structured questions pertinent to an individual case in order to elicit a family history.” The GCSES is scored on a 100-point scale in increments of 10, starting at 0 (“not at all certain I can do”), extending to 50 (“moderately certain I can do”), to 100 (“highly certain I can do”) (Caldwell et al., 2018a).

Locus of Control. Locus of control was measured by a score on the Work Locus of Control (WLOC) scale. Spector’s WLOC scale is a validated scale used to measure locus of control in a work setting (Spector, 1988). The WLOC scale contains 16 items and uses a 6-point Likert scale with answer choices: 1 = disagree very much, 2 = disagree moderately, 3 = disagree slightly, 4 = agree slightly, 5 = agree moderately, 6 = agree very much. The numbers from each item were added to determine a total score which could range from 16 to 96. The lower the individual’s total score, the more internal the individual’s work locus of control. An example question from the WLOC includes: “Getting the job you want is mostly a matter of luck.” The WLOC scale has been shown to have strong reliability with an average alpha coefficient of 0.83 (Spector, 1988).

Trait Anxiety. The trait subscale of the State Trait Anxiety Inventory (STAI) was used to measure whether the respondent had a high or low level of anxiety in general (Spielberger & Gorsuch, 1983). The trait anxiety subscale contains 20 items and uses a 4-point Likert scale

with the following answer choices: 1 = almost never, 2 = sometimes, 3 = often, 4 = almost always. Scores from the trait subscale were added to determine a total score which could range from 20 to 80. The higher the individual's total score, the higher the individual's level of trait anxiety. A sample question from the trait anxiety subscale includes: "I feel upset." The STAI has been shown to have strong reliability with median alpha coefficients of .90 for scores on the trait subscale (Spielberger & Gorsuch, 1983).

Board Certification Exam Performance. A set of close-ended questions related to board certification exam performance were created and pre-tested. These questions were asked of individuals who took the American Board of Genetic Counseling (ABGC) certification exam for the first time from January 2016 – August 2018. The questions related to board exam performance addressed (a) whether or not the individual had taken the board exam within the specified time-frame and (b) whether the individual passed on her or his 1st, 2nd, or 3rd attempt.

Data Analysis

Descriptive statistics were used to characterize the study population. Frequency (percentage) was reported for categorical variables while mean and standard deviation were reported for continuous variables. The predictors of interest were work locus of control, trait anxiety, and board certification exam performance. The outcome variables were six factor subscales of the GCSSES. For each participant, the average raw score was calculated for each factor of the genetic counseling self-efficacy tool.

Confirmatory factor analysis was performed on the 38 GCSSES items, assuming six factors and using maximum likelihood method and oblique solution. Model fit measures, such as SRMR (Standardized Root Mean Square Residual), RMSEA (Root Mean Square Error of Approximation)

and CFI (Comparative Fit Index) were reported to assess the validity of the GCSES six factors model. Spearman correlation was performed to test the association between the predictor / demographic variables (including years of genetic counseling experience) and GCSES factor (raw) scores. A multiple linear regression was performed in which all of the significant predictor/demographic/clinical variables were included to jointly assess the combined relationships with GCSES factor scores. Multicollinearity among variables was examined and VIF (variance inflation factors) larger than 4 was considered evidence of a high degree of multicollinearity. For those highly correlated, the variable with more complete data, years of experience, was included in the multiple linear regression model. The GCSES factor scores were log transformed to meet the normality assumption. A nominal p value threshold ($p < .05$) was applied for significance. All the analyses were performed in R software, version 3.22 (<https://www.r-project.org>).

Results

The entire population of 3,876 National Society of Genetic Counselors (NSGC) new and full members had the potential to be invited to participate in the survey. A total of 459 surveys were collected for an overall response rate of 12%. Three hundred and seventy respondents completed the majority of the online questionnaire and were included in the data analysis; eighty-nine respondents did not answer any questions for the WLOC scale and trait anxiety subscale of the STAI and were removed from the data analysis.

Demographics

Demographics of the sample are outlined in Table I. Participants were predominantly female (95%) and Caucasian/White (95%). Ages of participants ranged from 23 to 66. The

majority of the respondents had worked in a direct patient care position at some time throughout their career (95%) and the top three primary areas of practice in a direct patient care position were cancer (32%), general genetics (pediatrics or adult) (26%) and prenatal/preconception (22%). The majority of respondents (79%) stated their current position includes direct patient care.

Confirmatory Factor Analysis

Confirmatory factor analysis was performed on the 38 items on the GCSES using R package “lavaan”. The six factor model proposed by Caldwell et al. (2018a) was fitted. The model fit index showed an acceptable fit between the six-factor model and observed data with SRMR = 0.06 and the RMSEA = 0.09. The Comparative Fit Index (CFI) is 0.83 and the Tucker-Lewis Index (TLI) is 0.82.

Genetic Counseling Self-Efficacy with GC Skills

The mean and standard deviations of genetic counseling self-efficacy for each factor were reported across three studies in Table II. In the current study, the highest mean self-efficacy was for information gathering (96.2 ± 6.1) and the lowest mean self-efficacy was for complex skills (86.9 ± 11.1). This phenomenon was also observed in Caldwell et al. (2018b) study and Owens-Thomas et al. (2018) study. The mean GCSES score in the current study was higher for all six factors than those reported in genetic counseling students at the beginning of their second year of training (Caldwell et al., 2018b) and at the end of their second year of training (Owens-Thomas et al., 2018) (Table II).

Work Locus of Control and Trait Anxiety

The mean ($\pm SD$) work locus of control score for the overall sample population was 39.7 (± 8.3), with a range of 19-65. The mean ($\pm SD$) trait anxiety score for the overall sample population was 37.5 (± 8.7) with a range of 20-67.

The pearson correlation between work locus of control and trait anxiety was assessed. There was a modest positive correlation (0.33, $p < .001$) between scores on the work locus of control scale and scores on the trait subscale of the STAI; as WLOC scores increased towards more external, scores on the STAI increased towards higher trait anxiety.

Relationship Between Genetic Counseling Self-Efficacy and Other Variables

The raw factor scores of the GCSES were significantly negatively correlated with work locus of control for complex skills, communication, genetic testing, and genetic counseling process ($-0.15 \leq \rho \leq -0.11$, $p \leq 0.032$; Table III). The more internal the individual's work locus of control the higher the individual's self-efficacy for these factors. The raw factor scores of the GCSES were all significantly negatively correlated with trait anxiety scores on the STAI ($-0.17 \leq \rho \leq -0.11$, $p \leq 0.035$; Table III). The lower the individual's trait anxiety the higher the individual's genetic counseling self-efficacy.

Multiple demographic variables were examined to assess the relationship with the GCSES factors (Table III). The participant's age was positively correlated to the factors of complex skills, communication, basic psychosocial skills, genetic counseling process, and information gathering ($p \leq 0.01$). The participant's years of experience and years in a direct patient care position were both positively associated with all six factors ($p \leq 0.001$). All the correlations were moderate with spearman correlation coefficient ranging from 0.13 to 0.31 (Table III).

Age, years of experience, and years in a direct patient care position were highly correlated ($r \geq 0.81$). The variance inflation factor (VIF) of these three variables were all larger than 5.8, suggesting that a high degree of multicollinearity was present, therefore only years of experience, the one with more complete data, was included in the multiple linear regression model. Multiple linear regression models were performed to assess the combined effects of the significant predictor/demographic variables in which five variables (WLOC, trait anxiety, GC years of experience, if the GC ever had a DPC position, and whether their current position includes direct patient care) were included. After adjusting for the other four variables, the genetic counselor's years of experience were significantly associated with self-efficacy scores for complex skills, communication, basic psychosocial skills, genetic counseling process, and information gathering ($p < .001$, Table IV). If the genetic counselor had ever had a direct patient care position was significantly associated with self-efficacy for genetic counseling process and information gathering ($p < .001$, Table IV). The genetic counselor's current position, whether it included direct patient care (including mixed positions) or was in non-direct patient care, remained significant for all six factors of the GCSES ($p < .05$, Table IV).

Board Exam Performance and Genetic Counseling Self-Efficacy

There were 139 individuals who indicated they took the board exam for the first time within the three years prior to this study (January 2016 – August 2018). Of those 139 individuals, 126 (91%) passed on their first attempt and 13 (9.4%) did not pass on their first attempt. Given the low sample size, we were not able to determine if there was a relationship between board exam performance and factor scores on the GCSES, work locus of control, or trait anxiety.

Discussion

Scores of all six factors on the genetic counseling self-efficacy scale show similar relationships to work locus of control, trait anxiety, years of experience, and age, to what has been found with self-efficacy scales in other fields, thus further validating the GCSES (Barbee & Combs, 2003; Harper, 2008; Judge & Bono, 2001; Larson & Daniels, 1998).

The current study demonstrates preliminary evidence that genetic counselors' perception of their own actions impacting an outcome (internal LOC) is positively related to genetic counseling self-efficacy which is consistent with other locus of control studies in the literature (Harper, 2008; Judge & Bono, 2001). The current study also demonstrates preliminary evidence that genetic counselors' level of trait anxiety is negatively related to self-efficacy, which is consistent with studies in other professions (Barbee & Combs, 2003; Larson et al., 1992). The trait anxiety mean score on the STAI from the current study (37.5 ± 8.7) was consistent with a recent study of practicing genetic counselors (37.73 ± 9.06), showing overall higher levels of trait anxiety compared to norms provided for adult working women, indicating that our sample population seems consistent, from an anxiety perspective, with the genetic counselor population (Allsbrook et al., 2016; Spielberger & Gorsuch, 1983). This provides additional evidence that the GCSES performs similarly to self-efficacy tools in other fields.

Previous studies utilizing the GCSES showed that genetic counseling students average factor scores on the GCSES increased from the beginning of their second year to the end of their second year (Caldwell et al., 2018b; Owens-Thomas et al., 2018). However, Owens-Thomas et al. found that factor scores on the GCSES for second year genetic counseling students seemed to plateau between 80-100 core clinical cases. Although genetic counseling

self-efficacy was shown to plateau with students, the current study demonstrates that self-efficacy is higher on average among genetic counselors post-graduation. This may be because there are tasks a student may not have the opportunity experience due to limited time constraints in certain clinics or rotations. Whereas once the individual has graduated and is a practicing genetic counselor, she/he may have more opportunities to take on those particular roles/tasks and work on those skills, increasing their self-efficacy.

Multiple linear regression was used to look at the combined effect of all of the variables. Trait anxiety was still associated with two factors, complex skills and information gathering, once the demographic variables, such as years of experience and having a patient care role in one's current position, were taken into account. Once these demographic variables were taken into account, work locus of control was not associated with any of the six factors. The genetic counselors' years of experience was significantly related to complex skills, which makes sense because it may expected as a genetic counselor practices longer, she/he has the ability to continue to work on complex skills such as evaluating the need for intervention or referral for their clients and responding to transference and countertransference. In addition, genetic counselors' years of experience was significantly related to communication, basic psychosocial skills, genetic counseling process, and information gathering. It is possible that as years of experience increases, the GCs have opportunities to communicate more with their clients, to practice psychosocial counseling, to explain the genetic counseling process and to formulate targeted, structured questions pertinent to their clients which may help the genetic counselors become more comfortable with their skills. Whereas genetic counselors with fewer years of

experience may not be as confident with some of the tasks measured in the GCSES because they have had less opportunity to hone those particular skills.

The participant's years of experience was not related to the genetic testing factor of the GCSES. This may be due to the fact that the genetic testing available now is vastly different than genetic testing offered and available ten or more years ago. For example, gene panels are more widely used and ordered by genetics professionals now compared to ten years ago (Fecteau et al., 2014). It is, therefore, possible that years of experience does not particularly result in feeling more confident in current genetic testing practices. Another explanation could be that a genetic counselor's comfort with genetic tests plateaus earlier in her career than some other skills, therefore, we would not continue to see an increase of self-efficacy for genetic testing as the genetic counselor's years of experience increases.

Genetic counselors with more years of experience reported lower trait anxiety. This is similar to findings from a study of genetic counselors in which trait anxiety levels were lower for genetic counselors with >4 years of experience than genetic counseling students (Jungbluth et al., 2011; Lee et al., 2015). This notion is further supported by the finding that factor scores on the GCSES were negatively related with trait anxiety and positively related with years of experience. It is possible that anxiety decreases over time as genetic counselors gain more experience in their position, or it could be that genetic counselors that entered the field years ago have different personality characteristics, with lower levels of trait anxiety, than genetic counselors who entered the field more recently.

Whether the individual had ever been in a direct patient care position had a positive correlation with every factor on the GCSES. In addition, individuals in a current non-direct

patient care position had lower scores for every factor on the GCSES. This may be because the practice based competencies (PBCs) are more focused on roles that are typically taken on by clinical genetic counselors, and the GCSES is based on these PBCs. Therefore, it could be that individuals reporting a current non-direct patient care position have lower factor scores on the GCSES because the questions are tailored more towards roles traditionally taken on by clinically focused genetic counselors. It is important to note that the GCSES is not measuring competency, rather confidence in the individual's ability to complete certain tasks. In addition, although there is a significant difference in scores for individuals who reported they are in current non-direct patient care roles, their scores are still consistently high on all factors of the GCSES.

In the 2018 Professional Status Survey reported by NSGC, the percentage of genetic counselors citing non-direct patient care position as their primary work setting was 25% (NSGC Professional Status Survey, 2018). In the current study 21% of participants reported their primary work setting as non-direct patient care, suggesting again that our sample population seems representative of the profession. In a 2016 study of 121 laboratory genetic counselors, almost all participants (99%), regardless of lab type, reported performing duties with customer liaison and case coordination (Waltman et al., 2016). The most frequently performed role/task was to answer client/clinician questions regarding test algorithms and strategies (Waltman et al., 2016). Therefore, it makes sense that the factor with the smallest negative correlation with current non-direct patient care position was the genetic counseling process ($-.026, p=.014$). The genetic counseling process includes items such as contracting with clients to address emerging concerns, presenting the genetic counseling encounter information orally to other

health care providers, and discussing potential benefits, risks, and limitations of genetic/genomic testing with client, all of which are tasks often performed by genetic counselors working in laboratory settings. We acknowledge that not all genetic counselors working primarily in a non-direct patient care position work in a laboratory setting. The current study supports the suggestion that the roles outlined in the PBCs seem to be most representative of roles of genetic counselors in direct patient care.

In regards to the model fit indices from the confirmatory factor analysis, the SRMR met typical standards at .06 and the RMSEA was slightly above the standard (.09>.08). The CFI and TLI were below standards (CFI: .77<.90; TLI: .82<.95) but were higher than in previous studies utilizing the GCSES (Caldwell et al., 2018b; Owens-Thomas et al., 2018).

Study Limitations/Future Studies

There were several limitations to this study which supports the need for additional research in the area. The study relies on self-reported data, thus self-reporting bias may be a limitation. Social desirability bias may have led participants to present their self-efficacy responses based on where they believed their scores should be, rather than where their scores actually lied. In the current study, direct patient care was self-defined by the participants. Therefore, the way in which a participant defines direct patient care may differ among participants.

Overall, the mean self-efficacy scores were high for all factors. Thus, lack of variability between participants on the entry-level skills outlined in the PBCs may limit the ability to find meaningful differences in self-efficacy between participants in this study because the GCSES is

based on the PBCs. It is possible a different scale that could measure more advanced genetic counseling skills might demonstrate more variation and find more meaningful differences.

Although the response rate was about 12%, a larger sample size would help to further strengthen the analyses, specifically in regard to the board exam questions. Due to the low sample size of the board exam questions we were not able to draw any conclusions about the relationship between passing the boards exam and factors such as anxiety, locus of control, and genetic counseling self-efficacy. Further studies are needed in order to make conclusions about if a relationship exists between genetic counseling self-efficacy and board exam performance or other measures of competence. In addition, seeing as our response rate was 12%, it is possible that those who voluntarily chose to answer the survey are different from those who chose to ignore the survey. Perhaps an individual who possesses more self-efficacy or has more internal locus of control may be more likely to complete the survey. Thus, the overall high self-efficacy seen in the current study may just be representative of the sample population, but not the overall population of genetic counselors.

The current study measured the genetic counselors' belief in their own capabilities to perform tasks related to genetic counseling, rather than their competencies in these particular tasks. Therefore, further studies are needed to determine the relationship between genetic counseling self-efficacy and genetic counseling competencies. In addition, a future study is needed to determine if factor scores on the GCSES are related to genetic counselors' job performance, as self-efficacy has been related in other fields.

Conclusion

The current study further validates the use of the GCSES as an effective tool for measuring genetic counseling self-efficacy by demonstrating similar characteristics to measures of self-efficacy in other areas. The GCSES factor scores are positively related to internal work locus of control and negatively related to trait anxiety, similar to self-efficacy tools in other fields. Of all variables investigated in this study, the participants' years of experience was the most highly correlated with GCSES factor scores. These data suggest that genetic counselors' self-efficacy is related to their personality characteristics, but also is highly related to their years of experience. Further validation of this scale supports the usefulness of this tool as an outcome for genetic counseling training purposes – for example, to assess students' genetic counseling self-efficacy throughout their graduate studies. In addition, the GCSES could be used for self-reflective practice for genetic counselors. GC's self-assessment of their self-efficacy using the GCSES might identify areas of low self-efficacy to address through continuing education or mentorship. Alternatively, if a genetic counselor has a lower self-efficacy, maybe it is because she/he has higher anxiety which, if addressed, might in turn help increase self-efficacy.

Tables

Table I: Participant demographics characteristics

	n	Percentage (%)
Gender (n=370)		
Female	351	95%
Male	16	4%
Other ^a	2	0.5%
Race (n=379)		
Asian	13	3.5%
Asian Indian	8	2.2%
Black or African American	3	0.8%
White or Caucasian	351	95%
Other ^b	4	1.1%
Ethnicity (n=369)		
Not Hispanic or Latino(a)	359	97%
Hispanic or Latino(a)	7	2%
Prefer not to respond	3	0.8%
Ever worked in DPC position (n=370)		
Yes	353	95%
No	17	5%
Primary area of practice in DPC position (n=370)		
Cancer	117	32%
Prenatal/Preconception	81	22%
General Genetics (Pediatrics or Adult)	96	26%
Specialty Disease (Pediatrics or Adult)	51	14%
Other	9	2%
Did not respond	16	4%
Current Position (n=370)		
Direct patient care	243	66%
Non-direct patient care	76	21%
Mixed	48	13%
Did not respond	3	1%
Year Graduated from accredited GC Program (n=369)	n	Percentage
2013 - 2018	204	55%
2008 - 2012	67	18%
2000 - 2007	49	13%
Before 2000	49	13%
	Range	Median
Age (years)	23 - 66	31

*DPC = direct patient care

^a Other includes non-binary, third gender, and prefer not to respond

^b Other includes Arab and Middle Eastern, American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander, and Prefer not to respond

Table II: GCSES mean factor scores between early 2nd year genetic counseling students (Caldwell et al. 2018b), late 2nd year genetic counseling students (Owens-Thomas et al. 2018), and practicing genetic counselors (current study)

Factors	Caldwell et al. (2018b)			Owens-Thomas et al. (2018)			Current Study		
	Mean $\pm$ <i>sd</i>	median	range	mean $\pm$ <i>sd</i>	median	range	mean $\pm$ <i>sd</i>	median	range
Complex Skills	71.1 $\pm$ 14.8	73.8	18.8 - 98.8	83.4 $\pm$ 9.7	83.8	50.0 - 100.0	86.9 $\pm$ 11.1	88.8	43.8 - 100
Communication	80.5 $\pm$ 11.9	82.5	43.8 - 100.0	88.5 $\pm$ 8.6	90	63.8 - 100.0	91.6 $\pm$ 8.7	93.8	50.0 - 100
Genetic Testing	77.9 $\pm$ 11.1	78.8	41.3 - 100.0	86.6 $\pm$ 8.7	87.5	57.5 - 100.0	91.6 $\pm$ 8.4	93.8	53.8 - 100
Basic Psychosocial Skills	78.3 $\pm$ 14.5	82	36.0 - 100.0	89.0 $\pm$ 8.9	90	64.0 - 100.0	91.6 $\pm$ 8.9	94	56.0 - 100
Genetic Counseling Process	87.3 $\pm$ 9.5	90	51.7 - 100.0	92.2 $\pm$ 6.8	93.3	75.0 - 100.0	95.6 $\pm$ 6.4	98.3	60.0 - 100
Information Gathering	88.9 $\pm$ 9.5	90	60.0 - 100.0	93.0 $\pm$ 6.4	93.3	73.3 - 100.0	96.2 $\pm$ 6.1	100	56.7 - 100

Table III: Relationship of WLOC, STAI, demographic variables and GCSES subscale scores

	Complex Skills		Communication		Genetic Testing		Psychosocial Skills		Genetic Counseling Process		Information Gathering	
	<i>rho</i>	<i>p value</i>	<i>rho</i>	<i>p value</i>	<i>rho</i>	<i>p value</i>	<i>rho</i>	<i>p value</i>	<i>rho</i>	<i>p value</i>	<i>rho</i>	<i>p value</i>
Age	0.2	<0.001*	0.19	<0.001*	0.10	0.07	0.22	<0.001*	0.18	<0.001*	0.13	0.01*
Years of experience ^a	0.26	<0.001*	0.29	<0.001*	0.19	<0.001*	0.27	<0.001*	0.28	<0.001*	0.25	<0.001*
Ever DPC position?	0.08	0.14	0.11	0.04*	0.06	0.23	0.08	0.15	0.19	<0.001*	0.17	<0.001*
Years in DPC position **	0.31	<0.001*	0.31	<0.001*	0.26	<0.001*	0.30	<0.001*	0.31	<0.001*	0.29	<0.001*
Current position ^b	0.12	0.02*	0.13	0.01*	0.13	0.02*	0.1	0.045*	0.19	<0.001*	0.17	0.001*
WLOC	-0.11	0.03*	-0.14	0.006*	-0.12	0.019*	-0.08	0.11	-0.15	0.003*	-0.10	0.053
STAI	-0.13	0.01*	-0.13	0.017*	-0.11	0.035*	-0.17	0.002*	-0.17	0.001*	-0.12	0.021*

* significance ($p < .05$)

^a calculated by: (2018 - year graduated from accredited GC program)

^b direct patient care (including mixed positions) vs. non-direct patient care

Table IV: Relationship between demographic factors, WLOC, STAI and GCSES factors in a multiple linear regression model

	Complex Skills		Communication		Genetic Testing		Basic Psychosocial Skills		Genetic Counseling Process		Information Gathering	
	<i>beta</i>	<i>p value</i>	<i>beta</i>	<i>p value</i>	<i>beta</i>	<i>p value</i>	<i>beta</i>	<i>p value</i>	<i>beta</i>	<i>p value</i>	<i>beta</i>	<i>p value</i>
WLOC	-0.001	.20	-0.001	.067	-0.001	.092	-0.001	.40	-0.001	.076	-0.0003	.48
STAI	-0.002	.043*	-0.001	.063	-0.001	.15	-0.001	.16	-0.001	.077	-0.001	.042*
Years of experience	0.004	<.001*	0.003	<.001*	0.001	.15	0.003	<.001*	0.001	<.007*	0.001	<.001*
Ever DPC position	0.014	.72	0.030	.28	0.053	.055	0.017	.55	0.077	<.001*	0.067	<.001*
Current position ^a	0.053	.008*	0.043	.003*	0.034	.020*	0.035	.022*	0.025	.017*	0.030	.002*

* significance ($p < .05$), WLOC Work Locus of Control, STAI trait subscale of State Trait Anxiety Inventory, DPC direct patient care

^a direct patient care (including mixed positions) vs non-direct patient care

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Appendix

Data Collection Tool

Demographic Questions:

1. Have you graduated from an ACGC or ABGC accredited genetic counseling graduate program in the United States or Canada?
Yes No
2. What year did you graduate from an accredited genetic counseling program? _____
3. What is your age in years? _____
4. With which of the following do you identify?
Female Male Non-binary/third gender Other/prefer not to respond
5. What is your race?
American Indian or Alaskan Native Asian Asian Indian Black or African American
Native Hawaiian or Other Pacific Islander White or Caucasian Prefer not to respond
Other (please specify) _____
6. What is your ethnicity?
Not Hispanic or Latino(a) Hispanic or Latino(a) Prefer not to respond
7. Have you ever worked in a direct patient care position?
Yes No
8. How many years have you worked in a direct patient care position throughout your whole career (in whole years)? _____
9. In your most recent direct patient care position, what was your primary area of practice?
Cancer Prenatal/Preconception General Genetics (Pediatrics or Adult)
Specialty Disease (Pediatrics or Adult) Other
10. How would you classify your current position?
Please note: if you have more than one position, please answer for your primary position.
A direct patient care position A non-direct patient care position A mixed position
11. Do you consider English your primary language?
Yes No

Genetic Counseling Self-Efficacy Scale: A number of competencies are described below that may be part of a genetic counseling session. Please rate how certain you are that you can independently perform this competency today in a genetic counseling session.

0 10 20 30 40 50 60 70 80 90 100

Not at all certain I can do

Moderately certain I can do

Highly certain I can do

1. Accurately record a family history by drawing a pedigree using appropriate pedigree symbols.
2. Formulate targeted, structured questions pertinent to an individual case in order to elicit a family history.
3. Ask targeted questions in order to elicit pertinent information from a client's medical history.
4. Assess the accuracy with which a diagnostic genetic/genomic test identifies a client's clinical status (clinical validity).
5. Assess the value of a diagnostic genetic/genomic test for determining treatment and management (clinical utility).
6. Select the most appropriate laboratory and genetic/genomic test for the given clinical situation.
7. Discuss potential benefits, risks, and limitations of genetic/genomic testing with a client.
8. Discuss potential costs of genetic/genomic testing with a client.
9. Facilitate the ordering of appropriate genetic/genomic testing for the client.
10. Interpret the clinical implications of genetic/genomic test reports.
11. Evaluate familial implications from genetic/genomic test results.
12. Incorporate the results of screening, testing, family history, environmental and lifestyle factors, and other relevant information to provide accurate risk assessment for clients (e.g. probability of carrier status, cancer risk assessment)
13. Modify the case management plan as needed in order to incorporate changes in management and surveillance recommendations.
14. Present the genetic counseling encounter information orally to other health care providers in a clear and concise manner (e.g. case presentation to physician).
15. Document the genetic counseling encounter information in accordance with professional guidelines and standards (e.g. medical record documentation; letters to other providers).
16. Identify appropriate resources, services and support for a client.
17. Establish a mutually agreed upon genetic counseling agenda with the client.
18. Explain the genetic counseling process to a client.

19. Contract with the client throughout the encounter to address emerging concerns.
20. Assess pertinent information relating to psychosocial history such as client emotions, individual and family experiences, beliefs, behaviors, values, coping mechanisms, and adaptive capabilities.
21. Respond with empathy to client's emotions and concerns.
22. Respond to a client's emotional and behavioral cues, expressed both verbally and non-verbally.
23. Respond to a client using normalization in a genetic counseling session.
24. Utilize anticipatory guidance in a genetic counseling session.
25. Utilize advanced empathy in a genetic counseling session.
26. Utilize in-depth exploration of client responses to risks and options.
27. Evaluate the need for intervention and referral for a client based on their psychosocial needs.
28. Implement evidence-based models of counseling to a genetic counseling session as appropriate (e.g. short-term client-centered counseling, grief counseling, crisis counseling).
29. Facilitate client decision-making that is consistent with the values of the client.
30. Maintain professional boundaries by ensuring directive statements, self-disclosure, and self-involving responses are in the best interest of the client.
31. Respond to client-counselor relationship dynamics, such as transference and countertransference.
32. Utilize an appropriate degree of directive or non-directive guidance for specific genetic counseling encounters.
33. Respond to client cultural beliefs relevant to the genetic counseling session.
34. Utilize risk communication principles and theory to maximize client understanding.
35. Communicate relevant genetic information to a client to help them better understand certain conditions.
36. Communicate with clients in a way that is clear and unambiguous based on the client's needs and circumstances of the encounter.
37. Present balanced descriptions of lived experiences of people with various conditions to a client.
38. Respond to ethical and moral dilemmas that may arise in genetic counseling practice.

Work Locus of Control Scale(WLOC): Please respond to each statement with the response choice which you more strongly believe (Spector, 1988).

Disagree very much Disagree moderately Disagree Slightly Agree Slightly Agree moderately Agree very much

1. A job is what you make of it.
2. On most jobs, people can pretty much accomplish whatever they set out to accomplish.

3. If you know what you want out of a job, you can find a job that gives it to you.
4. If employees are unhappy with a decision made by their boss, they should do something about it.
5. Getting the job you want is mostly a matter of luck.
6. Making money is primarily a matter of good fortune.
7. Most people are capable of doing their jobs well if they make the effort.
8. In order to get a really good job you need to have family members or friends in high places.
9. Promotions are usually a matter of good fortune.
10. When it comes to landing a really good job, who you know is more important than what you know.
11. Promotions are given to employees who perform well on the job.
12. To make a lot of money you have to know the right people.
13. It takes a lot of luck to be an outstanding employee on most jobs.
14. People who perform their jobs well generally get rewarded for it.
15. Most employees have more influence on their supervisors than they think they do.
16. The main difference between people who make a lot of money and people who make a little money is luck.

State Trait Anxiety Inventory, Trait Subscale: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you GENERALLY feel (©1968, 1977 Charles D. Spielberger. All rights reserved in all media. Published by Mind Garden, Inc., www.mindgarden.com).

Almost never

Sometimes

Often

Almost always

1. I feel pleasant
2. I feel nervous and restless
3. I feel satisfied with myself
4. I wish I could be as happy as others seem
5. I feel like a failure
6. I feel rested
7. I am "calm, cool, and collected"
8. I feel like difficulties are piling up so that I cannot overcome them
9. I worry too much over something that really doesn't matter

10. I am happy
11. I have disturbing thoughts
12. I lack self-confidence
13. I feel secure
14. I make decisions easily
15. I feel inadequate
16. I am content
17. Some unimportant thought runs through my mind and bothers me
18. I take disappointments so keenly that I can't put them out of my mind
19. I am a steady person
20. I get in a state of tension or turmoil as I think over my recent concerns and interests

Board Certification Exam Performance

1. Did you take the American Board of Genetic Counseling (ABGC) certification examination for the first time within the past 3 years (between January 2016 – August 2018)?

Yes No

2. When did you attempt the ABGC board certification exam for the first time?

February 2016	August 2016	February 2017	August 2017
February 2018	August 2018		

3. What was the outcome of your first attempt in taking the ABGC board certification exam?

Pass Not pass Prefer not to respond

4. Have you taken a second attempt of the ABGC board certification exam?

Yes No

5. When did you attempt the ABGC board certification exam for the second time?

August 2016	February 2017	August 2017	February 2018
August 2018			

6. What was the outcome of your second attempt in taking the ABGC board certification exam?

Pass Not pass Prefer not to respond

7. Have you taken a third attempt of the ABGC board certification exam?

Yes No

8. When did you attempt the ABGC board certification exam for the third time?

February 2017	August 2017	February 2018	August 2018
---------------	-------------	---------------	-------------

9. What was the outcome of your third attempt in taking the ABGC board certification exam?

Pass

Not pass

Prefer not to respond