EMPIRICAL RESEARCH

The Social Ties That Bind: Social Anxiety and Academic Achievement Across the University Years

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Abstract Given that engagement and integration in university/college are considered key to successful academic achievement, the identifying features of social anxiety, including fear of negative evaluation and distress and avoidance of new or all social situations, may be particularly disadvantageous in the social and evaluative contexts that are integral to university/college life. Thus, the purpose of this study was to examine the direct effects of social anxiety on academic achievement, as well as investigate an indirect mechanism through which social anxiety might impact on academic achievement, namely, the formation of new social ties in university. The participants were 942 (71.7 % female; $M = 19$ years at Time 1) students enrolled in a mid-sized university in Southern Ontario, Canada. Students completed annual assessments of social anxiety, social ties, and academic achievement for three consecutive years. The results from an autoregressive cross-lag path analysis indicated that social anxiety had a significant and negative direct relationship with academic achievement. Moreover, the negative indirect effect of social anxiety on academic achievement through social ties was significant, as was the opposing direction of effects (i.e., the indirect effect of academic achievement on social anxiety through social ties). These findings highlight the critical role that social ties appear to play in successful academic outcomes and in alleviating the effects of social anxiety during university/college.

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Introduction

The ethos today in Western cultures is that success in university/college is one important gateway to future prosperity and wellbeing. Higher education is known to be associated with health and happiness, as well as reduced crime rates and lower welfare costs, to name a few (McMahon and Oketch 2013). Yet students often face many changes (e.g., moving away from the nuclear family, creating new social networks) and challenges (e.g., achieving academically) as they make their way through university/college (e.g., Mitchell et al. 2008). While many students navigate this transitional time successfully, others are confronted by difficulties in both achievement and psychosocial adjustment. One psychosocial factor that may hinder success in university/college is social anxiety, an emotional problem that often is overlooked or hidden from the casual observer.

Social anxiety is not inconsequential in institutions of higher learning. Depending on the threshold of diagnosis, prevalence rates of social anxiety in university/college students range from 10 to 33 % as compared to 7–13 % in the general population (e.g., see Parade et al. 2010; Russell and Shaw 2009). Given that engagement and integration (i.e., involvement in the various social and academic activities of university/college life) are considered key to successful academic achievement (see Tinto 2006), the identifying features of social anxiety, including fear of negative evaluation and distress and avoidance of new or all social situations (Ginsburg et al. 1998), may be especially disadvantageous in the social and evaluative contexts

that are integral to the university/college setting. In fact, Russell and Topham (2012) propose that social anxiety may have a negative impact on university/college students' academic achievement.

The goal of the present study was to test whether social anxiety is directly associated with academic achievement over time among university/college students, and second, to investigate a proposed indirect mechanism through which social anxiety might be linked to lower academic achievement—that is, through the restricted formation of new social ties in university/college (Goguen et al. 2010), a task that is particularly challenging for socially anxious individuals. It is important to note that in this paper we refer to social anxiety symptoms found within the general population and not to clinically diagnosed Social Anxiety Disorder (also known as Social Phobia) diagnosed in clinical populations. Further, our definition of academic achievement refers to overall academic achievement in university/college (i.e., overall year-end academic grades) as compared to more specific circumstances of achievement, such as test taking or performance in an examination.

Theoretical Perspectives: Social Anxiety, Social Ties, and Academic Achievement

There are many theories that postulate on the factors that best predict successful academic achievement in university/college, with some focused on the social interactions occurring within the university setting (i.e., college impact or interindividual theories; see Pascarella and Terenzini 2005), and others focused more on the individual (i.e., developmental, self-presentation, or intraindividual theories; see Pascarella and Terenzini 2005). For example, the college impact theories of Tinto's Theory of Student Departure (2006) or Astin's Theory of Involvement (1999) suggest that engagement and integration in the social systems of university/college life (i.e., experiencing rewarding encounters within the university/college community that lead to the sharing of normative values and attitudes with both peers and faculty) are critical predictors of successful academic achievement (also see Chickering and Reisser 1993). However, thoughts of engaging or interacting with others might foster the social fears that are central to social anxiety, hindering any attempt to participate in the classroom, join in conversations, or ask for help in order to successfully maneuver through the university/college system. Thus, from this viewpoint, socially anxious or withdrawn individuals might be at a disadvantage academically if they tend to avoid the social and academic communities of an institution.

Developmental theories also are relevant to understanding why engagement is important to academic success in university/college, most particularly Erikson's (1966) stage theory of psychosocial development. In the sixth

stage, labeled intimacy *versus* isolation, Erikson hypothesized that a successful transition through early adulthood should involve the development of a healthy sense of identity as opposed to isolation. Individuals entering into institutions of higher education face the challenge of integrating into a new social and academic context, where their interactions with the social environment are likely to reshape their identity through changing attitudes, values, and goals. From this perspective, individuals who are socially anxious might perceive the university/college social environment as somewhat threatening, which, in turn, would restrict their openness to change (e.g., identity re-evaluation and gaining independence from the nuclear family) and inhibit their interactions' with others (e.g., developing intimacy within new friendships, and engaging professors and teaching assistants in discussion). As a consequence, feelings of social distress and avoidance in the university/college context might prevent socially anxious individuals from taking advantage of the learning opportunities that are designed to bolster academic success in school.

Finally, the self-presentation theory of Schlenker and Leary (1982) focuses on the individual and specifically addresses a proposed indirect link between social anxiety and academic achievement. Schlenker and Leary hypothesized that individuals likely become socially anxious when they wish to make a good impression on others but anticipate that they will be unsuccessful. Leary (2010) further proposed that socially anxious individuals perceive most relationships to be unbalanced by default, through a predisposing fear that others will not value the relationship as highly as they do. The consequence of this "relationship devaluation" is an inability for socially anxious individuals to obtain their own particular interpersonal objectives through their relationships with others. From this standpoint (i.e., a predisposing fear of social failure), socially anxious students likely have difficulty engaging friends, peers or faculty in any goodwill to support their present or future interpersonal goals, including achieving favorable academic outcomes through group study or discussions. Thus, poor self-presentation may translate into difficulties in developing new social ties at university/college and trouble in obtaining the support of others to achieve academic objectives (e.g., Goguen et al. 2010). Overall, these theoretical perspectives on the importance of engagement, psychosocial development, and self-presentation in the university/college context suggest that social anxiety may interfere with achieving academic success, perhaps through difficulties in establishing social ties.

Social Anxiety and Academic Achievement

To the best of our knowledge, only two research groups have tested the hypothesis that social anxiety is directly and

inversely associated with academic achievement in university/college. In a study of 253 university/college students, Strahan (2003) found that social anxiety was not a significant predictor of college persistence or grade point average over time. Topham and Moller (2011) duplicated this result in a smaller sample of 117 university/college students, although neither study took advantage of their longitudinal design to control for previous scores on academic achievement or to control for comorbidity with general anxiety and depressive symptoms. In contrast, research on other populations found that Social Phobia in older adults was linked with poorer educational achievement (Van Ameringen et al. 2003), and trajectories of general anxiety throughout elementary school were associated with later high school non-completion (Duchesne et al. 2008). Given the limited research assessing the longitudinal relationship between social anxiety and academic achievement specifically, a direct test of this hypothesis over time with a larger sample size of university/college students is needed.

Although Strahan (2003) did not find a direct link between social anxiety and grade point average in her research, she speculated that the effect between social anxiety and academic achievement might be indirect; that is, social anxiety might impact on academic achievement through difficulties in the formation of new social connections. Indeed, Strahan found that social anxiety was significantly correlated with overall university/college adjustment (e.g., social integration), and university/college adjustment was significantly correlated with academic persistence and grade point average, although the indirect effect from social anxiety to academic persistence and grade point average through university/college adjustment was not formally tested in the study. We also propose that there might be an indirect effect of social anxiety on academic achievement specifically through socially anxious individuals' difficulties in forming new social ties, as social ties are theorized to be an important determinant in social adjustment (Leary and Kowalski 1995) and critical to integration and successful academic achievement in university/college (Tinto 2006). We next outline research that provides support for this hypothesis, albeit through separate lines of research—one line that assesses the association between social anxiety and social ties, and another line that examines the link between social ties and academic achievement.

Social Anxiety and Social Ties

Given the key deficits associated with social anxiety (i.e., fear of negative evaluation, distress and avoidance of new or all social situations), it is not surprising that researchers have investigated its maladaptive effects on social relationships. Overall, this research indicates that social anxiety is contemporaneously associated with fewer close and intimate friendships in adolescence (Festa and Ginsburg 2011; La Greca and Harrison 2005; La Greca and Lopez 1998). Two prospective studies also reported that social anxiety was negatively associated with the emergence of companionship and intimacy in newly formed adolescent friendships (Biggs et al. 1992), although only one of these studies took advantage of the prospective design and controlled for previous scores on companionship and intimacy (Vernberg et al. 1992). Finally, longitudinal research examining the bidirectional associations between social anxiety and adolescent friendship found that social anxiety predicted lower friendship support among males but, in turn, friendship support did not predict lower social anxiety in either sex (Tillfors et al. 2012).

Despite both concurrent and longitudinal support for a link between social anxiety and social ties, the evidence seems to rest almost exclusively on younger adolescent populations, except for one study by Parade et al. (2010) that focused on female university/college students. Parade and colleagues found that socially anxious students had significantly more difficulty forming friendships than students who were not socially anxious, although the direction of effects between social anxiety and ease of forming friendships was unclear as they were measured concurrently. Nevertheless, Parade et al. (2010) suggested that their evidence supported the view that socially anxious female students are less confident in engaging others and may evaluate any relationship more negatively than students who are less socially anxious.

Notwithstanding the work of Parade et al. (2010), there appears to be a scarcity of literature on university/college students with respect to investigating both longitudinal and reciprocal relationships between social anxiety and social ties, most specifically new friendships formed in university/college. Based on evidence from the adolescent literature, however, it is expected that socially anxious students in university/college may be more withdrawn and have greater difficulty forming new friendships (Biggs et al. 2012) than their peers at a time when engagement and involvement are important to successful university/college outcomes (Tinto 2006). As well, students who do not have the emotional support of newly formed close friends may have difficulty overcoming their fear of being negatively evaluated or participating in the numerous social events that occur as a normal part of post-secondary educational pursuits. In fact, evidence from the work of Vernberg et al. (1992) on early adolescence suggests that there may be reciprocal effects between social anxiety and friendship; that is, their study indicated that social anxiety predicted the formation of fewer social ties in early adolescence and,

in turn, less intimacy and companionship was associated with either stable or greater levels of social anxiety over time. In summary, data from a number of studies support the suggestion that there may be a direct relationship between social anxiety and social ties, while much less research hints at an opposing direction of effects.

Social Ties and Academic Achievement

Previous research indicates that social ties are related to academic achievement in university/college. For instance, Fass and Tubman (2002) reported that peer attachment and friendship quality were concurrently associated with scholastic engagement and competence, and in turn, scholastic engagement and competence were concurrently associated with grade point average. In the same vein, longitudinal investigations have revealed that friendship quality or having new best friends in university/college predicated better social and academic outcomes (i.e., adjustment, aspirations, grade point average; Antonio 2004; Buote et al. 2007; Goguen et al. 2010; Swenson et al. 2008). Thus, the findings so far indicate that close social ties are important to favorable academic outcomes in the university/college environment.

Although empirical studies to date link close social ties with better academic adjustment or achievement in post-secondary institutions, much of the work assessed these associations concurrently (e.g., Fass and Tubman 2002; Swenson et al. 2008) or only over the first year of university (e.g., Antonio 2004). A stronger interpretation of these relationships is necessary, specifically through the adoption of a longitudinal design that accounts for temporal order and reciprocal associations among the variables. Indeed, Mackinnon (2012) studied the direction of effects between perceived social support (note that this measure did not specifically assess the formation of new friendships in university/college) and academic achievement (i.e., grades) in a population of students transitioning between high school and university/college, and found that higher levels of perceived social support did *not* predict higher levels of academic achievement over time, but higher academic achievement did predict higher levels of perceived social support. Overall, the evidence from the literature quite strongly supports a connection between friendships or social ties in university/college and academic outcomes, and to a much lesser extent, an opposing direction of effects.

Sex Considerations

Some prior research on social anxiety points to sex differences in prevalence, with girls typically reporting more symptoms than boys (e.g., La Greca and Lopez 1998; La Greca and Harrison 2005). Yet, other studies report no sex differences (e.g., Biggs et al. 2012). These mixed findings suggest that sex should be included as a covariate in any model testing. Likewise, sex differences in the pattern of results have been revealed with respect to the association between social anxiety and social ties. For example, socially anxious girls have reported less support, companionship, and intimacy in their close friendships than socially anxious boys, and both socially anxious boys and girls displayed poorer social functioning than those who were less socially anxious but the relationships were stronger for girls (La Greca and Lopez 1998; Vernberg et al. 1992). Biggs et al. (2012) showed similar findings. They found that an indirect effect of social anxiety on friendship quality through social withdrawal was significant only for girls. Although the accumulated evidence indicates that social anxiety is more likely to have a stronger effect on female as opposed to male social ties, there also is research that supports an opposing view. Tillfors et al. (2012) found that social anxiety predicted decreases in friendship support for males, but not for females. Collectively, these results indicate that sex should be examined as a moderator of the relationship between social anxiety and social ties.

Finally, sex also may emerge as an important moderator of the association between social ties and academic achievement in university/college contexts as there are key differences in the quality of friendship between males and females, with females reporting significantly closer and more intimate friendships than males (e.g., Sharabany et al. 1981). As a consequence, these sex differences may translate into divergent effects on the pattern of associations among social anxiety, social ties, and academic achievement, although the direction of effects is uncertain.

Current Study

Several empirical questions arose from the review of the literature on relationships among social anxiety, social ties, and academic achievement. Specifically, the purpose of this three-wave longitudinal study was to test in a large sample of university students the pattern of associations among social anxiety, social ties, and academic achievement. First, given past research, we hypothesized that there may be a negative direct relationship between social anxiety and academic achievement over time (Duchesne et al. 2008; Van Ameringen et al. 2003). Second, we hypothesized that there may be a negative indirect relationship between social anxiety and academic achievement through social ties. We also investigated the opposing direction of effects (e.g., academic achievement to social anxiety), although this analysis was exploratory given the

lack of research examining these reciprocal effects. Third, we hypothesized that sex may be a significant moderator of the results, given that socially anxious females, for example, often report less intimacy in their friendships than socially anxious males, and the link between social anxiety and social functioning often is stronger for females than males (e.g., La Greca et al. 1992). Finally, we tested for reciprocal effects over time between social anxiety and social ties, and academic achievement and social ties, although these analyses also were exploratory since there was a scarcity of research investigating these reciprocal relationships. A measure of general anxiety was controlled for in all analyses in order to assess the unique effect of social anxiety (over and above any general anxiety) on social ties and academic achievement (e.g., Epkins and Heckler 2011). As well, depressive symptoms were included as a covariate to control for the known co-morbidity between social anxiety and depressive symptoms (e.g., Starr et al. 2011). We also included age, sex, and parental education as covariates in the analyses given that these variables often are associated with academic achievement, social anxiety, social ties (e.g., La Greca and Lopez 1998; McAndrew and Jeong 2012; Tavernier and Willoughby 2013, 2015; Tynkkynen et al. 2012).

Method

Participants

The participants were 1132 students that were part of a cohort enrolled in a mid-sized university in southern Ontario, Canada, who were surveyed for three consecutive years. First and second year surveys were administered by trained research assistants, while surveys in the third year were completed online. As academic grades were an important component of the present study, we excluded from our analyses the students who dropped out or transferred out of the university ($N = 190$), as grades were not applicable or available. Therefore, our analyses were based on 942 students (71.7 % female participants—note that the overall university male/female student ratio at Time 1 was 42/58 %) who remained registered at the university during the three waves of the study (note that we reran the analyses with the full sample and the pattern of findings did not differ). At the first assessment, all participants were in their first year of university ($M = 19.01$ years, $SD = 0.90$, range $= 17$–25 years). Data on socioeconomic status indicated that mean levels of education for mothers and fathers fell between "some college, university, or apprenticeship program" and "completed a college/apprenticeship and/or technical diploma." Our sample was composed predominantly of domestic-Canadian students (88 %), and

common ethnic backgrounds of these students other than Canadian were British (19 %), Italian (16.8 %), French (9.5 %), and German (9 %), consistent with the broader demographics for the region (Statistics Canada 2006). Of the international students, the majority were from Asia (36.1 %), the European Union (15.7 %), the Caribbean (10.2 %), and Africa (10.2 %).

Procedure

First-year university students from a broad variety of academic disciplines (e.g., biology, business, history, kinesiology, linguistics, nursing, psychology, etc.) were invited to complete a survey examining factors related to stress, coping, and adjustment to university by way of posters, classroom announcements, website posting, and visits to on-campus student residences. The participants were given course credit or monetary compensation for their participation at Time 1 ($10), and monetary compensation for their participation at Time 2 ($20) and Time 3 ($30). At Times 2 and 3, all students who participated in the first assessment were invited to participate again by way of e-mails, posters, and classroom announcements. At all three assessments, surveys were completed during the winter term (end of January to March). Trained research assistants administered the survey in person to groups of students for Times 1 and 2, and online for Time 3. The study was approved by the university ethics board prior to survey administration at all three assessments and all participants provided informed active consent prior to participation.

Missing Data

Missing data occurred within each assessment time point because some students did not finish the entire questionnaire (average missing data = 2.2 % across the three time points), and because some students did not complete all three waves of the survey. In our sample ($N = 942$), 72.2 % completed all three assessments, 18.4 % completed two of the three assessments, and 9.4 % completed only one of the three assessments; therefore, retention was high. The participants who completed the survey at all three time periods were not significantly different from participants missing one or two waves on any of the study measures, with one exception. The participants who completed the survey at all three waves had significantly higher academic achievement than their peers who completed only one (ps $< .001$, mean difference of 4.20, 4.54, and 5.72 for Times 1, 2, and 3, respectively) or two waves (ps $< .001$, mean difference of 3.49, 4.18, and 5.58 for Times 1, 2, and 3, respectively). Missing values were imputed using the EM (expectation-maximum) algorithm

with all demographic and study measures in the imputation process, including academic achievement (Little et al. 2014). EM is an iterative maximum-likelihood (ML) procedure in which a cycle of calculating means and covariances followed by data imputation is repeated until a stable set of estimated missing values is reached. Methodological research has demonstrated that ML estimation is preferable to pair-wise deletion, list-wise deletion, or means substitution (Schafer and Graham 2002).

Measures

All measures were assessed at each time period with the exception of the five covariates, namely, age, sex, parental education, anxiety and depressive symptoms, which were measured at Time 1.

Demographics

Age, sex, and parental education (one item per parent, using a scale from $1 = did\ not\ finish\ high\ school$ to $6 = professional\ degree$, which was averaged for participants reporting on both parents, $r = .40$ between mother and father education) were assessed and used as covariates in the analyses.

Anxiety

The Penn State Worry Questionnaire (PSWQ; Meyer et al. 1990) was used to assess trait anxiety and general anxiety disorders (see Davey 1993; Meyer et al. 1990). We used a shortened 7-item version of the original 16-item scale (due to time constraints we could not include the full scale). An example item was, "I know I should not worry about things, but I just cannot help it". Items were measured on a 5-point Likert scale ranging from $1 = not\ at\ all\ like\ me$ to $5 = completely\ like\ me$. The internal consistency for this scale was .80 at Time 1, similar to Davey (1993) who used the full PSWQ with 136 university students.

Depressive Symptoms

The Center for Epidemiologic Studies Depression Scale (CES-D Scale; Radloff 1977) measures depressive symptoms in the general population. There are 20 items in this scale (e.g. "I thought my life had been a failure"), which are measured on a 5-point Likert scale ranging from $1 = none\ of\ the\ time$ to $5 = most\ of\ the\ time$. At Time 1 the internal consistency for this scale was .91, consistent with other studies, such as Asante and Andoh-Arthur (2015) and Willoughby and Fortner (2014).

Social Anxiety

Social anxiety was assessed using the Social Anxiety Scale for Adolescents (SAS-A; La Greca and Lopez 1998). An adolescent measure was used as our sample involved late adolescents, consistent with the age range recommended for the SAS-A measure. The self-report instrument was comprised of three subscales including fear of negative evaluation (5 items, e.g., "I worry about what other people my age think of me"), social avoidance and distress of new situations (4 items, e.g., "I only talk to other people my age that I know really well"), and social avoidance and distress generally (5 items, e.g., "I feel shy even with other people my age I know well"). The responses were based on a 4-point Likert scale ranging from $1 = almost\ never\ or\ never$ to $4 = almost\ always\ or\ always$. Consistent with past research, the 14 items were combined into a composite measure of social anxiety (La Greca and Lopez 1998; due to time constraints we could not use all 18 items from the original scale). A reliability analysis of the SAS-A scale at Times 1, 2, and 3 gave Cronbach's alphas of .89, .90, and .91, respectively, consistent with other studies on older adolescents (e.g., La Greca and Harrison 2005). In the present study, individuals who have social anxiety symptoms at 1 SD above the mean (average score $= 2.23$) might be considered to be at-risk for social anxiety (Tulbure et al. 2012).

Social Ties

The social ties construct was compiled from three questions on the Student Adaptation to College Questionnaire (SACQ, Baker and Siryk 1989). We operationalized this construct through a principal components analysis of the SACQ that grouped together the three items focusing on the formation of new social ties in university/college (factor loadings were between .73 and .78). Given the length of the SACQ and that we were investigating many variables over time, we were not able to include the entire SACQ in the survey. The questions included: "I have several close social ties at university", "I am satisfied with how much I am participating in social activities at university", and "I am meeting people and making friends at university". Students rated the relevance of each statement on a 5-point Likert scale ranging from $1 = not\ at\ all\ like\ me$ to $2 = completely\ like\ me$. Cronbach's alphas at Times 1, 2, and 3 were .69, .73, and .76, respectively.

Academic Achievement

Overall year-end academic grades across all courses were accessed from the university's Registrar's Office with permission granted from the participants (only $n = 19$ or 2 % of students did not consent to having their grades accessed).

Analytic Approach

An autoregressive cross-lag path analysis was employed in the present study to allow for the testing of direct, indirect, and reciprocal pathways, while controlling for previous scores on the study variables (Selig and Little [2012]). Model fit was determined using the comparative fit index (CFI) and the root mean square error of approximation (RMSEA) indicators of goodness-of-fit (Hu and Bentler [1999]). The cut-off criteria recommended by Hu and Bentler for a well-specified or close-fitting model are a CFI > .95 and a RMSEA < .06, simultaneously. The analyses were carried out using AMOS 22.

The Model

The autoregressive model was comprised of three variables measured over three waves: social anxiety, social ties, and academic achievement (Fig. [1]). Across the three time periods, we included the following paths: lag-1 (i.e., from Times 1 to 2, and Times 2 to 3) cross-lag paths between social anxiety and social ties and between social ties and academic achievement, lag-1 (i.e., from Times 1 to 2, and Times 2 to 3) and lag-2 (i.e., from Times 1 to 3) autoregressive paths (i.e., within variable) for social anxiety, social ties, and academic achievement, and lag-2 (i.e., from Times 1 to 3) cross-lag paths between social anxiety and academic achievement. Concurrent associations among social anxiety, social ties, academic achievement, and all covariates (age, sex, parental education, anxiety, and depressive symptoms) were included at each time point in order to control for common method variance. Paths were estimated from the covariates at Time 1 to the study variables at Times 2 and 3. Any significant paths, therefore, accounted for the correlations among the variables within a wave, and controlled for previous scores on the outcome variables, covariates, and other predictors in the model (i.e., to allow estimation of the unique relationship between study variables).

Invariance Testing

We first assessed whether the pattern of results was invariant across time (e.g., we determined if the relationship between Time 1 social anxiety and Time 2 social ties was the same as between Time 2 social anxiety and Time 3 social ties). Each cross-lag path was constrained to be equal across time and compared to an unconstrained model where the paths were left free to vary. A chi-square difference test of relative fit was used to ascertain whether there was a difference in model fit between the constrained and unconstrained models. Non-significance would indicate no difference in fit between the two models and the more parsimonious constrained model would be kept for

further hypothesis testing (i.e., simplest model with fewest parameters being estimated).

To test whether sex was a significant moderator of the results, we constrained each cross-lag path to be equal across sex and compared that model to an unconstrained model where the paths were left free to vary. A non-significant chi-square difference test would indicate no difference in fit between the constrained and unconstrained models and that sex was not a significant moderator of the pattern of effects.

Results

Descriptive Statistics

The descriptives for all study variables were analyzed using SPSS 22 and the means and standard errors are listed in Table [1]. Although the social anxiety measure used in this study is not necessarily comparable to measures used to clinically diagnose Social Anxiety Disorder, the prevalence of social anxiety at 1 SD above the mean was 15.5, 13.1, and 12.7 % at Times 1, 2 and 3, respectively, similar to other studies in the literature (e.g., Topham and Moller [2011]). To test whether there were any sex differences in the three study variables, three MANOVAs were conducted separately for social anxiety, social ties, and academic achievement at each time point, with sex as the independent variable. Only the MANOVAs at Times 2 and 3 revealed a significant main effect ($ps < .001$). Females reported significantly higher grades and higher levels of social ties than males at Time 2 ($p < .001$ and $p < .05$, respectively), and higher grades than males at Time 3 ($p < .001$).

Primary Analyses

Time Invariance

The chi-square difference test of relative fit indicated that the unconstrained model was not a significantly better fit than the constrained model, $\chi^2_{\text{diff}} (4) = 6.995$, $p > .05$, suggesting that the pattern of associations among the variables was consistent across the 3 years. Therefore, we used the constrained model for all further analyses, as it was the most parsimonious. The constrained model fit was good, $\chi^2 (12) = 24.700$, $p = .016$, CFI = .997 and RMSEA = .034, 90 % CI [.014 .052], $p = .922$.

Social Anxiety and Academic Achievement

We tested our first hypothesis by analyzing whether there was a direct effect of social anxiety on academic achievement and found that social anxiety at Time 1 was a
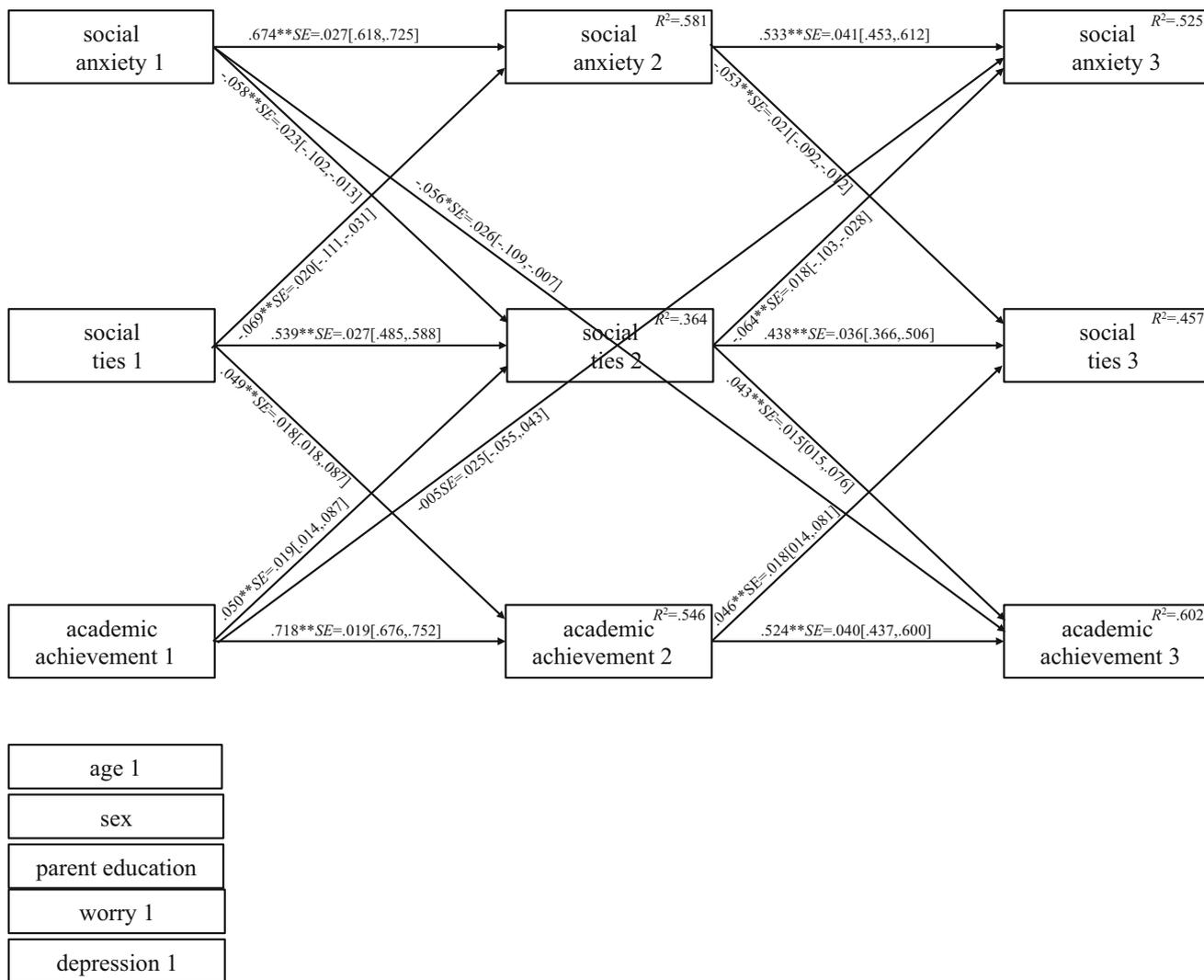
Fig. 1 Lag-1 and lag-2 *direct* paths among social anxiety, social ties, and academic achievement, and lag-1 autoregressive paths are shown. Numbers 1 = Time 1, 2 = Time 2, and 3 = Time 3. Standardized coefficients are reported with their standard errors and 95 % CI in brackets (from bias-corrected bootstrapping samples of 1000). R^2 is also given. In order to facilitate interpretation of the results the following paths are not drawn: lag-2 autoregressive pathways, the direct pathways between the covariates at Time 1 and the study variables at Times 2 and 3, the correlations at Time 1 among the study variables and covariates, and the contemporaneous correlations between study variables at Times 2 and 3 (results can be obtained from the first author). *$p < .05$. **$p < .01$

negative and significant predictor of academic achievement at Time 3, while academic achievement at Time 1 *was not* a significant predictor of social anxiety at Time 3—see Fig. 1. Thus, our findings showed a negative direct effect of social anxiety on academic achievement.

Social Anxiety, Academic Achievement, and Social Ties

With the same constrained model, we used bias-corrected bootstrapping (to calculate confidence intervals and significance levels for the indirect coefficients; bootstrap samples = 1000; see Zhao et al. 2010) to test whether there was an indirect effect of social anxiety at Time 1 on academic achievement at Time 3 through social ties at Time 2 and found a significant negative relationship—see Fig. 2. The negative indirect effect of academic achievement at Time 1 on social anxiety at Time 3 through social ties at Time 2 also was significant. Thus, we found reciprocal negative indirect effects between social anxiety and academic achievement through social ties.

Secondary Reciprocal Associations

Our model also revealed that social anxiety at Time 1 negatively predicted social ties at Time 2, and, in turn, social ties at Time 1 negatively predicted social anxiety at

Table 1 Means and standard deviations for all variables

Variable	M (SD)
Sex	71.7 % female
Age 1	19.01 (0.89)
Parental education	3.68 (1.27)
Anxiety 1	3.14 (0.83)
Depression 1	2.09 (0.64)
Social anxiety 1	1.74 (0.51)
Social anxiety 2	1.73 (0.49)
Social anxiety 3	1.73 (0.50)
Social ties 1	3.24 (0.90)
Social ties 2	3.22 (0.87)
Social ties 3	3.21 (0.91)
Academic achievement 1	68.85 (9.55)
Academic achievement 2	69.34 (9.35)
Academic achievement 3	72.67 (10.25)

Higher scores equal higher levels of the construct. Numbers 1, 2, and 3, represent Times 1, 2, and 3, respectively

Time 2. Further, social ties at Time 1 positively predicted academic achievement at Time 2, and academic achievement at Time 1 positively predicted social ties at Time 2

(note that as the lag-1 cross-lag pathways were constrained to be the same over time, the pattern of results for Times 2–3 was identical to those for Times 1–2). Thus, our results indicated significant negative reciprocal relationships between anxiety and social ties, and positive reciprocal associations between social ties and academic achievement (Fig. 1).

Sex as a Moderator

We examined whether the pattern of effects was divergent across sex as proposed by the third hypothesis. There was no significant difference in model fit between males and females, $\chi^2_{\text{diff}}(5) = 2.107$, $p > .05$, indicating that the pattern of associations across time was not different across sex. Therefore, sex did not moderate the pattern of effects among social anxiety, social ties, and academic achievement.

Discussion

This study analyzed the longitudinal relationships among social anxiety, social ties, and academic achievement in university/college students. Overall, we found that
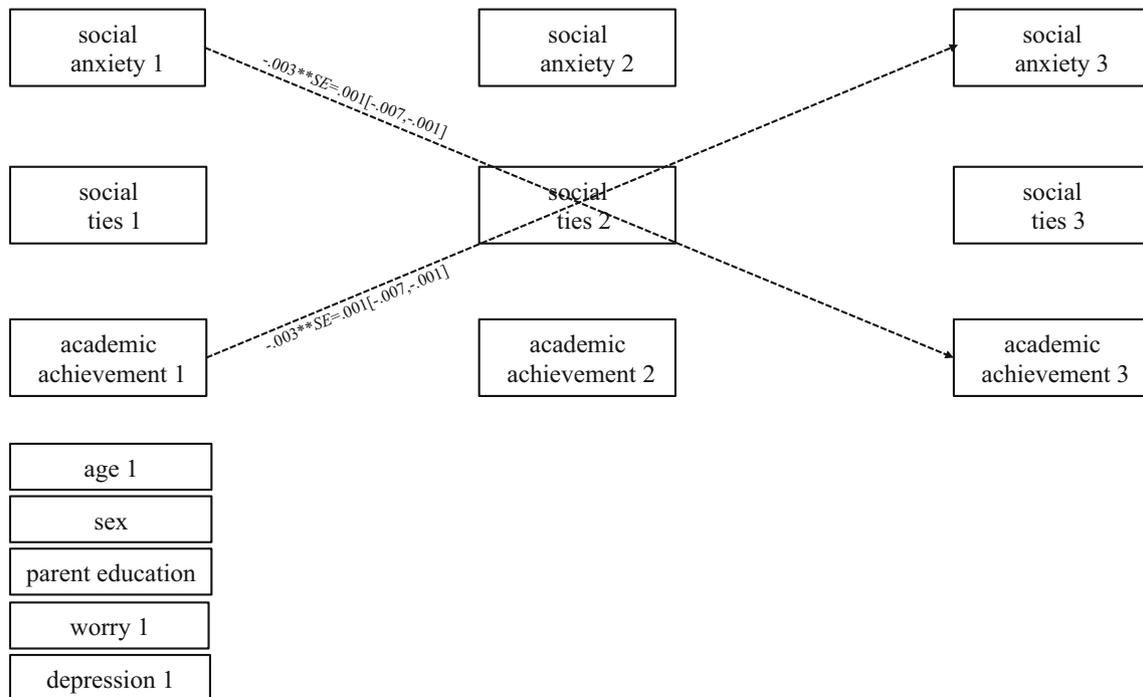

Fig. 2 The significant *indirect* pathways between social anxiety and academic achievement through social ties are shown. Numbers 1 = Time 1, 2 = Time 2, and 3 = Time 3. Standardized coefficients are reported with their standard errors and 95 % CI in brackets (from bias-corrected bootstrapping samples of 1000). In order to facilitate interpretation of the results the following paths are not drawn: lag-1 and lag-2 autoregressive pathways, the cross-lag pathways between social anxiety and social ties, and between social ties and academic achievement, all of which can be found in Fig. 1. Also not shown are the direct pathways between the covariates at Time 1 and the study variables at Times 2 and 3, the correlations at Time 1 among the study variables and covariates, and the contemporaneous correlations between study variables at Times 2 and 3 (results can be obtained from the first author). **$p < .01$

13–15 % of the students reported social anxiety levels greater than 1 *SD* above the mean. More explicitly, we investigated whether there was a significant direct effect between social anxiety and academic achievement, as well as reciprocal indirect effects through social ties, and found evidence to support both these hypotheses. Significant reciprocal relationships over time also were found between social anxiety and social ties, as well as between social ties and academic achievement.

The finding that higher levels of social anxiety were significantly and directly linked to lower levels of academic achievement over time is congruent with the self-presentation theory of Schlenker and Leary (1982). Socially anxious individuals may have difficulty engaging with the academic environment as a consequence of their fear that others will not value them equally within a relationship or social interaction. This fear may further inhibit their willingness to participate in class and ask for help or information from teaching assistants, professors, and other university staff. It also may indicate that socially anxious students have greater difficulty within the academic structure of the university as a whole, where approaching and interacting with, and being evaluated by others is a normal part of the learning process.

We also found that social anxiety was associated indirectly with academic achievement through social ties. This finding is in line with our hypothesis of an indirect effect, which pulls together two areas of research, namely, one that focuses on the associations between social anxiety and fewer or poorer quality social ties or friendships, and the other that links friendship or peer relationships with better academic outcomes. More specifically, in the last couple of decades, social anxiety has been associated with disengagement from peer interactions, fewer best friends, less companionship and emotional support from friends (e.g., La Greca and Lopez 1998), withdrawal and poorer friendship quality (e.g., Biggs et al. 2012), and interference with the development of close supportive ties (e.g., Vernberg et al. 1992). Overall, social anxiety appears to disrupt the formation of close social ties and our results support this contention. Moreover, our evidence underscores the importance of engaging in social tasks during the developmental transition through university/college, as it appears that social and academic goals are linked.

Indeed, our findings on the positive relationships between social ties and academic achievement are consistent with another part of the extant literature, in which connections have been established between friendship and positive outcomes in university/college (i.e., higher grade point average or better academic adjustment; e.g., Goguen et al. 2010; Swenson et al. 2008; Woolf et al. 2012). Moreover, we extend the literature by introducing a factor that might inhibit the formation of social ties, specifically

social anxiety. Given social anxiety's defining symptoms of fear of negative evaluation, distress, and avoidance of social interactions, it may be that socially anxious individuals partially or entirely forgo the advantages that accrue with making new social ties in university/college, a situation that is particularly detrimental since friendships have been noted as primary sources of guidance, support, security, and a means by which academic resources and information are directly shared, to name just a few (e.g., Buote et al. 2007; Tokuno 1986). Despite the evidence critically linking social engagement to academic success (see review by Pascarella and Terenzini 2005), concern also has been expressed that achieving engagement across the entire student population at the practical (rather than theoretical) level is not easily accomplished (Tinto 2006). To this end, our results suggest specifically targeting some engagement strategies toward socially anxious students, particularly in helping them overcome their reticence in forming new social ties in university/college, which, in turn, might have a beneficial impact on their academic accomplishments.

In terms of our hypothesized reciprocal direction of effects, we also found that academic achievement predicted social anxiety over time, through social ties. Although there is minimal evidence in the literature to support this pathway, our results are in line with a three-wave cross-lag path analysis in which Mackinnon (2012) found a significant association between grades and social support (but surprisingly no evidence for the opposing direction of effects). He proposed that the finding was consistent with research showing that hard work in academia leads to better self-concept or self-esteem that, in turn, may lead to richer more satisfying social ties or friendships (Baumeister et al. 2003). While we concur with the idea that students who likely gain confidence in themselves through their academic accomplishments will be more comfortable in reaching out to their peers and accessing the support that comes with friendship, our research suggests that there also may be additional benefits for those who are vulnerable to the symptoms of social anxiety.

In consideration of the second component of this indirect path (i.e., social ties to social anxiety), our finding was consistent with Vernberg et al.'s (1992) proposal that there are reciprocal associations between social anxiety and certain aspects of friendship. Other research also has demonstrated that best friendships with positive qualities are related to less social anxiety, indicating that friendships may serve in a protective capacity by reducing social anxiety (La Greca and Harrison 2005). Our study is consistent with this view that social relationships confer a protective factor on those who are at risk to the effects of social evaluative fears and withdrawal behavior. Indeed, problematic relationships with peers probably contribute to

the emergence of social awkwardness and avoidance of social situations, all symptoms of social anxiety. In turn, social withdrawal likely elicits negative feedback from peers and exacerbates feelings of social rejection (e.g., Biggs et al. 2012; Rubin et al. 2010). Thus, our results support the idea that successful academic achievement in university/college alongside the formation of social ties may be helpful in alleviating the effects of social anxiety. More generally, our findings indicate that an implementation of strategies that encourage the development of new social relationships at university/college would be advantageous on several fronts, both in achieving successful academic outcomes and in relieving some of the detrimental effects of social anxiety.

In summary, our findings support past research that outlines the many benefits of friendship, including intimacy and companionship (Berndt 1982), emotional or social support (Furman and Buhrmester 1992), favorable short and long term adjustment (Rubin et al. 2010), positive self-esteem and better psychosocial adjustment (Buhrmester 1990), as well as its capacity to provide an overall "protective function", particularly in reducing social anxiety (La Greca and Harrison 2005; La Greca and Lopez 1998; Vernberg et al. 1992). Not only do social ties appear to help the socially anxious individual become socially engaged and more comfortable in social contexts but they also may diminish the effects of social anxiety by facilitating academic adjustment and success in the university/college environment.

Finally, there were no sex differences in mean levels of social anxiety and the pattern of results found among social anxiety, social ties, and academic achievement was not different across males and females. Both of these findings were somewhat unanticipated as adolescent girls have reported higher levels of social anxiety than boys (e.g., La Greca and Lopez 1998; La Greca and Harrison 2005), and they have described their friendships differently; socially anxious girls have reported their friendships as less supportive and intimate than do socially anxious boys (La Greca and Lopez 1998; Vernberg et al. 1992). However, these findings on sex differences are mostly limited to younger adolescent populations and may not be applicable to our older sample.

The strength of the present study was in investigating the associations among social anxiety, social ties, and academic achievement using a long-term longitudinal research design with a large sample size. We used an autoregressive cross-lag analysis to control for previous scores on study measures (i.e., controlling for temporal order), to incorporate major covariates (particularly those known to be comorbid with social anxiety, such as general anxiety and depressive symptoms), and to control for shared method variance among variables within the same wave.

At the same time, our study is not without limitations. First, these findings may not apply to the general population as they were based on a single university sample. An advantage of using one university sample, however, is that we were able to develop a strong relationship with the participants, and thus, retention has been high over time (see missing data section for values). In addition, the pattern of findings from this study is unlikely to be unique to students at our university, although these results may unfold differently within younger age groups or different cultures. Second, our collection of data was yearly and it might be beneficial in future to assess these relationships more frequently. Third, on average, those who completed all three waves of the survey had higher grades than those who completed only one or two waves. It may be that students who completed all three waves are more conscientious than students completing only one or two waves, and thus more likely to respond each year to invitations to complete the survey. To avoid any potential bias, however, we included academic achievement in all missing data estimation analyses. Fourth, the alpha level for social ties at Time 1 was just below the conventional value of .7 for "adequate" acceptance, however, this might be due partly to the scale consisting of only three items, as reliability values decrease with fewer items in the scale. Fifth, although we focused on new social ties as relevant to the central feature of "social fears" associated with social anxiety, investigation of other interpersonal processes (e.g., friendship quality) also might inform the relationship between social anxiety and academic achievement. Interest also has been expressed in studying individual differences in emotionality as relevant to understanding predictors of academic achievement (Valiente et al. 2012). It may be that emotional dysregulation moderates the relationship between social anxiety and academic outcomes. Alternatively, a person-centered approach might tease apart subgroups of individuals with differing levels of social anxiety symptoms that diverge with respect to their pattern of relations with social ties, friendship qualities, or emotional regulation. Finally, some of the coefficients in this study were small compared to conventional sizes. However, small effect sizes are common in cross-lag models when accounting for the correlations among the variables within wave, and controlling for previous scores on the outcome variables, covariates, and other predictors in the model (Adachi and Willoughby 2014). Thus, small effects would be expected.

Conclusions

The findings of this study impact two traditional areas of research: social anxiety and academic achievement. We found that social anxiety had a direct effect on academic

achievement over the university/college years. A fear of negative evaluation alongside a greater tendency of feeling distressed and avoiding social situations seemed to interfere with academic achievement. Furthermore, newly formed university/college social ties appeared to play a pivotal role through their reciprocal relationships with both social anxiety and academic achievement, allowing us to bridge two areas of research. Those students with higher levels of social anxiety may be more successful in their academic pursuits when they embrace new social connections in the university environment, and those who achieve more favorable academic outcomes seem to engage in the formation of new social ties that seem to alleviate social anxiety symptoms. Broadly, we interpret the evidence to suggest that social ties have an overall protective function in these transitional years between adolescence and adulthood, particularly with respect to the link between social anxiety and academic achievement.

Over the last several decades, welcome programs, frosh week, and one-on-one mentorships have been implemented with some success to engage students in university/college life with the goal of leading students to successful integration and academic outcomes (e.g., Robinson et al. 1996). Our findings suggest that perhaps welcome program coordinators might consider specifically targeting individuals who are socially anxious or who are at risk for displaying withdrawn behavior. Given the prevalence of social anxiety in our sample, our findings may be of practical interest to socially anxious individuals and university administrators whose common goals are ultimately focused on promoting a smooth and successful transition through university/college.

Author Contributions CB conceived the study, participated in the design of the study, performed the statistical analyses, and participated in the drafting of the manuscript; TW helped conceive the study, participated in the design and coordination of the study, performed the statistical analyses, collected the data, and participated in the drafting of the manuscript. Both authors read and approved the final manuscript.

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