

THESIS

THE EVOLUTION OF SOCIAL NETWORKS IN A GROUP-BASED MENTORING
PROGRAM FOR VULNERABLE TEENS: WHAT TYPES OF RELATIONSHIPS MATTER
MOST?

Submitted by

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ABSTRACT

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CHAPTER I: INTRODUCTION

When an adolescent is struggling to develop in a positive way, an adult mentor can be a catalyst for change (Wesely, Dzoba, Miller, & Rasche, 2017). As a result, numerous mentoring programs for at-risk adolescents have emerged, including Big Brothers Big Sisters of America (<https://www.bbbs.org/>) and MENTOR (<https://www.mentoring.org/>). Alongside these traditional dyadic mentoring programs (i.e., one mentor, one mentee), group-based mentoring programs are another common structure. In these programs, one mentor may be matched with multiple mentees or mentor-mentee pairs may participate in larger group settings. Examples of group-based mentorship programs include Campus Connections (<https://www.chhs.colostate.edu/cc/>) and Go Girls! (<https://www.bbbsso.ca/programs/go-girls/>). While mentoring programs of various types and styles are ubiquitous in communities across the United States, findings from meta-analytic reviews indicate that the treatment effects of mentoring interventions vary widely across programs, structures, and outcomes (DuBois, Portillo, Rhodes, Silverthorn, & Valentine, 2011). Thus, efforts to maximize treatment efficacy is needed, and this endeavor requires focused research.

The fundamental element of any mentoring program is the bond that the mentee forms with others in the program. That is, with their mentor, in the case of a dyadic mentoring program. Or, in the case of group-based mentoring programs, with mentors and other mentees. Thus, one approach to improving mentoring treatment effects is to optimize the bonds and friendships cultivated during the mentoring program. In this thesis, my focus is on enhancing the treatment effects of group-based mentoring programs in particular. Mentees have an opportunity to build relationships with many different individuals in a group-based mentoring program, thus,

it is important to consider what types of bonds are most important for treatment effects to be realized. That is, to discover what types of relationships with other members of the group are most associated with positive program outcomes. For example, is it most important for a mentee to develop a close bond with their primary mentor, and/or with a set of mentors, and/or with other mentees in the program? If clarity about the most important relationships for an adolescent to cultivate during a group-based mentoring program can be gained, then this information may be used to restructure programs to maximize positive treatment effects.

In this thesis, I will characterize the evolution of the social network of mentees participating in a 12-week, group-based mentoring program for at-risk adolescents. Characterization of each mentee's social network over the course of the program will involve assessment of the number and strength of bonds with their primary mentor, with other mentors and adult staff, and with other mentees participating in the program. These measures of the social network will be collated and then used as predictors of a key program mediator (sense of belonging in the program) and several key program outcomes (i.e., academic performance, depression, anger, and delinquent behaviors). In this way, new insights into the types of relationships most salient for positive program outcomes may be discovered.

Commented [H1]: Is this now incorporated in your methods?

Commented [Y2R1]: I like to think so.

Adolescence – a critical time for intervention

Decades worth of research demonstrates that adolescence is a unique and consequential developmental period (Steinberg, 2007), and adolescents cannot be simply considered older children or younger adults (Crosnoe & Johnson, 2011). Numerous biological changes occur during adolescence. For example, pubertal development has been associated with increased activation of the frontal lobe, pruning and myelination of the brain (Paus, Keshavan, & Giedd, 2008; Steinberg, 2007). Additionally, there is enhanced capacity to the dopaminergic reward

system of the brain (Siegel, 2015). Changes in the nucleus accumbens, a brain area associated with reward seeking, have also been seen in adolescent development (Galvan et al., 2006).

Amidst these critical biological developments, adolescents are prone to impulsivity, sensation-seeking, and inaccurate assessment of vulnerability (Steinberg, 2007). Thus, health-risking behaviors (Arthur et al, 2002; Broidy et al, 2003; Resnick et al., 1997), including substance use (Henry, Thornberry, & Huizinga, 2009), unsafe sexual practices (Myklestad & Rise, 2007) and violence (Resnick et al, 1997; Reiss & Roth, 1993) are most common during this developmental period. Longitudinal models indicate that depressive symptoms are often formed during adolescence (J. R. Cohen, Andrews, Davis, & Rudolph, 2018). Additionally, adolescents are at risk for various psychiatric illnesses such as schizophrenia, substance use disorders, and anxiety disorders (Paus et al., 2008). Such disorders have been found to continue into adulthood (Rohde et al. , 2013). Indeed, adolescence is a critical period for development, prosocial behaviors and the key to lifelong health and well-being. Interventions designed to maximize health and prosocial development during adolescence are of critical importance.

Certain personal and contextual factors increase the likelihood that an adolescent will engage in risk behaviors, particularly risk behaviors that threaten prosocial and healthy development. In the literature, young people exposed to these personal and contextual risk factors are commonly labeled as *at-risk adolescents*. These personal and contextual factors can negatively contribute to an individual's ability to thrive academically, socially, emotionally, and/or physically (Mcdaniel & Yarbrough, 2016). At-risk adolescents are more likely to escalate problem behaviors, such as drug abuse (Mcdaniel & Yarbrough, 2016), poor academic performance (Malecki & Demeray, 2006) and school misconduct (Schmidt, 2003). Given these considerations, preventive efforts are needed to minimize behavioral difficulties amongst at-risk

adolescents. This is particularly salient for the design of targeted interventions, as many existing interventions of this sort are specifically designed for at-risk adolescents (Raposa et al., 2019). These complexities will be discussed in terms of the current thesis in subsequent sections.

Mentorship Interventions

One promising intervention to promote positive adolescent outcomes among at-risk youths is mentorship. Mentorship programs provide adolescents with a role model from the community in which they both reside. Mentors are encouraged to enhance their mentee's coping strategies, help their mentee reduce stressors, and create an attachment to the youth mentee (DeWit et al, 2016). Meta-analytic reviews show that adolescents in mentorship programs improve in behavioral and psychosocial outcomes as compared to their non-mentored counterparts (DuBois et al., 2011; Tolan, Henry, Schoeny, Lovegrove, & Nichols, 2014). A more recent meta-analysis found the averaged effect size of mentorship interventions across several outcomes (i.e. cognitive functioning, psychological, health) to be $\bar{g} = 0.21$ (Raposa et al., 2019), which constitutes a small effect size in terms of Cohen's (1988) behavioral sciences effect size guidelines and a medium/moderate effect size in terms of universal youth prevention programs (Tanner-Smith, Durlak, & Marx, 2018). However, results are not always positive. For example, a meta-analytic review by Wood and Mayo-Wilson (2012) found mentorship intervention effect sizes to be small, and in some cases iatrogenic, for academic achievement, attendance and negative behavior (i.e., school misconduct, drug use). Thus, while mentoring is considered an evidence-based practice, more work to understand for whom and under what conditions mentoring leads to better outcomes for participants is needed.

The promises and perils of group-based mentoring initiatives

This thesis is focused specifically on group-based mentoring, which carries its own set of potential promises and perils. A group-based approach to mentorship can have several benefits. For example, group-based mentoring allows programs to serve a larger number of youths at once. Similar to dyadic (one on one) mentoring, group mentorship has seen promotions in resiliency and prosocial attitudes (Kuperminc, Chan, Hale, Joseph, & Delbasso, 2019; Weiler et al., 2015). However, group-based mentoring can also produce challenges. If the group-based mentoring program is focused on exclusively at-risk adolescents, then the act of congregating the at-risk adolescents may produce unwanted outcomes. This phenomena is described by Dishion and colleagues as deviancy training (Dishion, Eddy, Haas, Li, & Spracklen, 1997). Deviancy training is the process in which congregated deviant youth have a tendency to endorse and encourage negative and rule-breaking behavior (Poulin, Dishion, & Haas, 1999). Unfortunately, at-risk youth in group-based mentorship programs may be at risk to learn negative behaviors from each other as a result of deviancy training (Dishion & Tipsord, 2011). Friendship networks, formed during group interventions for at-risk youth, can be a root cause of deviancy training (Dishion & Tipsord, 2011; Poulin et al., 1999). Group-based mentorship interventions need to be aware of such unintended consequences. There are effective strategies to prevent social deviancy in group interventions. Some protective moderators against the effects of deviancy training include adult monitoring, supervision, and structure (Dishion & Tipsord, 2011). Despite the known protective factors against negative deviancy training, not all group-based mentorship programs may utilize positive practices.

Youth mentoring programs have a rich history of providing positive outcomes to youth. For one, youths who participate in youth mentoring programs are much more likely to graduate

from high school as opposed to their non-mentored counterparts (J. Rhodes, 2005). Research also indicates that youths with a mentor have better school attendance outcomes and better attitudes towards school (Jekielek, Moore, Hair, & Scarupa, 2002). Additionally, youths with volunteer mentors are less likely to partake in delinquent behaviors (J. Rhodes, 2005). However, differences in outcomes exist for group mentoring programs. In general, group mentoring shows more stagnant effects in terms of academic outcomes compared to traditional dyadic mentoring programs (Cummings, 2010). On the other hand, group mentoring programs show promising effects in terms of behavioral problem outcomes (Deutsch, Reitz-Krueger, Henneberger, Futch Ehrlich, & Lawrence, 2017).

Belongingness as an Intermediate Goal of Group-based Mentoring Programs

An important aspect of any group-based mentorship program is perceived belongingness to the program. Belongingness is the need to gain acceptance within a community (Malone, Pillow, & Osman, 2012). Belongingness is an essential psychological need (Galliher, Rostovsky, & Hughes, 2004) and has been studied for decades in adolescent research (Slaten, Rose, Bonifay, & Ferguson, 2018). Baumeister & Leary (1995) explain that belongingness is a fundamental part of forming relationships with adolescent peers. Prior evidence suggests that youth who report a greater sense of belonging are more likely to have higher levels of expressed relationship satisfaction (Marsh & Evans, 2009). Additionally, research conducted by Gummaden, Pittamen and Ioffe (2016) showed having a higher sense of belonging in school has positive impacts on psychological well-being. This general benefit of feeling a sense of belonging is likely extended to belonging within youth programs. For instance, measures of belonging have been positively correlated with program attendance in youth development programs (Anderson-Butcher &

Conroy, 2002). Developing a sense of belonging for youth is often a central goal of youth programs (Anderson-Butcher & Conroy, 2002). As such, a deep understanding of how belongingness is formed is essential. Two such features that lead to enhanced belongingness in youth interventions are group characteristics and staff practices (Akiva, Cortina, Eccles, & Smith, 2013).

We can also explain the need to measure sense of belongingness in a mentoring intervention from a theoretical perspective. Maslow (1943) famously indicates love and belonging as the third tier on the hierarchy of human needs. Thus, explaining its importance to humans and adolescents alike. Additionally, prosocial bonds between youth are theoretically and empirically implicated in the development of delinquent behavior (Hirschi, 2017). As such, it is important to examine an adolescent's feeling of belongingness they form while participating in a social program focused on building positive friendships with peers.

A sense of belongingness in a group-based mentoring program is likely a necessary intervening variable that links program participation with the ultimate desired outcomes (e.g., decreased depression). That is, I hypothesize that a sense of belonging must be realized in order for a child to benefit from a group-based mentoring program. Without a sense of belonging, an adolescent is unlikely to benefit from the mentoring program. There is empirical support for this notion. Belongingness has been shown to mediate the relationship between social connections and achievement outcomes (Walton, Cohen, Cwir, & Spencer, 2012). Overall, people feel an innate need to maintain positive social bonds with one another (Baumeister & Leary, 1995). Furthermore, belonging to a group has a deep and profound impact on our attitudes and behaviors (G. L. Cohen, 2003; Walton et al., 2012). As such, I posit that an adolescent must gain

a sense of belongingness in order to benefit from the program. That is, I assert that belongingness serves as an important mediator in any group-based program.

The feeling of belonging may be formed by social connections. Even a small, weak, connection may cause even a mere sense of belongingness (Walton et al., 2012). For example, Cwir and colleagues (2011) found that sharing preferences with a confederate stranger increased emotions and physiological arousal of a participant. Findings from Cwir and colleagues (2011) illustrate the impact of having even a subtle feeling of social connectedness. Further research shows belongingness predicts youth protective factors, such as engagement in a youth program (Anderson-Butcher & Conroy, 2002).

For my thesis, I plan to examine belongingness as an important mediator between social ties and several key developmental outcomes (e.g. academic achievement, anger, depression). My specific model can be seen in Figure 1. I predict that more social ties will be associated with a greater sense of belongingness, and a greater sense of belongingness will be associated with improved developmental outcomes. From this model, I will be able to identify the indirect effect ($a*b$ path) of social ties through belongingness. The c' path will represent the direct effect of social ties on the developmental outcomes.

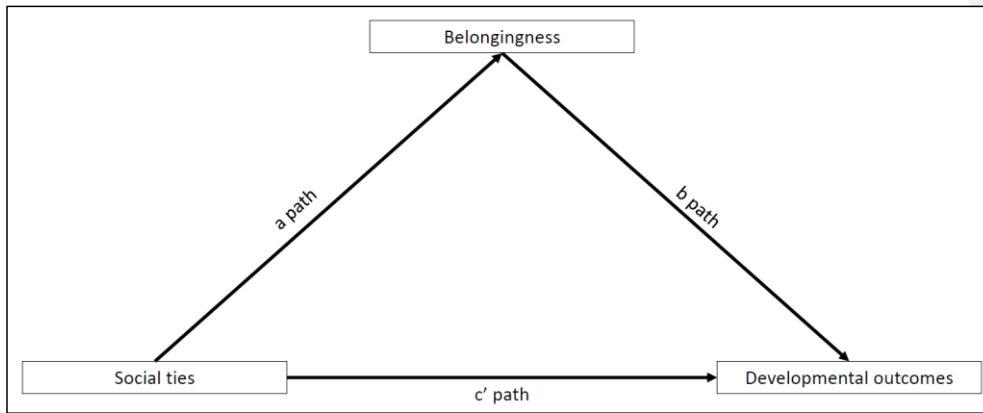


Figure 1. Proposed mediation model.

Social Networks

For this thesis, I plan to understand how the strength of social connections lead to a sense of belonging, which will be a prime intermediate variable linking social ties to the key outcomes (i.e., academic performance, depression, anger, and delinquent behaviors). I plan to use social network statistics derived from [social network analysis](#) to answer my research questions. A social network approach will shed light on how adolescents in a group-based intervention develop social [connections](#) and, from these ties, garner an enhanced sense of belonging in the program and ultimately experience better developmental outcomes. Using a social network approach, I can help to identify what aspects of bonds formed in a group-based mentorship intervention may contribute the most to an adolescent's sense of belonging and ultimately to better developmental outcomes. In this section, I describe [social network statistics](#) in greater detail and how [social network statistics](#) will be used to answer my research questions.

Defining Social Networks and Social Network Statistics

A social network is the structure of relationships that connect people within a defined population. Every network consists of a set of actors (nodes) with defining characteristics (e.g., role in the program – mentee, mentor) and lines to represent the connections between them (known as [connections](#), [ties](#), or edges). The [connections](#) are directed, indicating whether the relationship is one-sided or reciprocal. For example, consider Figure 2, which depicts potential relationships between two nodes. In panel 1, Node A reports an outgoing connection with Node B, but Node B reports no connection with Node A (no incoming [connection](#) from Node B to Node A) – this is an unreciprocated [connection](#). In panel 2, Node A reports a connection with Node B and Node B reports a connection with Node A – this is a reciprocated [connection](#). Panel 3 presents a more complex social network with many nodes. Notice that some nodes (e.g., Node A) have many outgoing [connections](#) (i.e., the actor reports that he has a connection with many other actors) while other nodes (e.g., Node G) reports few connections with other actors. Some nodes (e.g., Node B) have many reciprocated connections, while others have few reciprocated connections (e.g., Node C). Notice that some nodes (e.g., Node D) are very well connected in the network, they have many incoming and outgoing [connections](#), while other nodes (e.g., Node F) are not well connected in the network, and there is even one node (Node H) which is completely isolated (they have no incoming or outgoing [connections](#)).

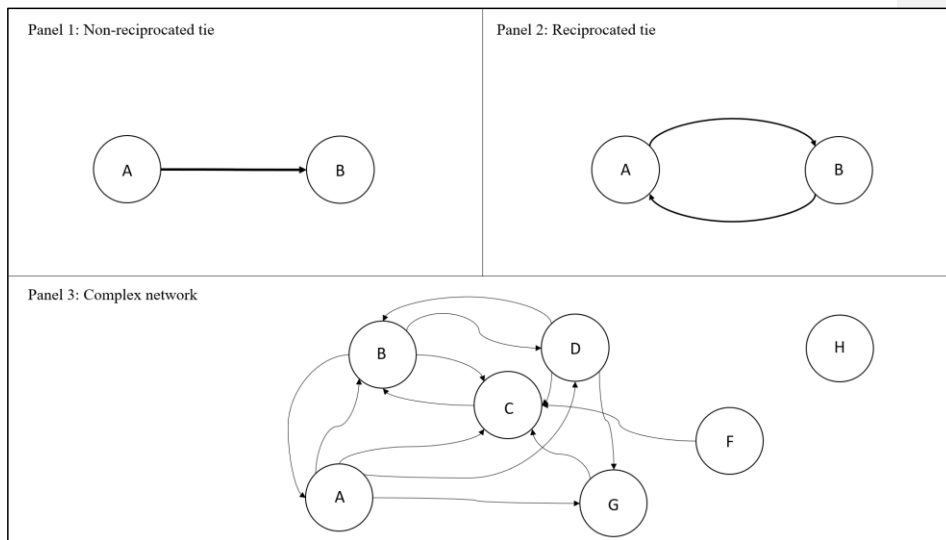


Figure 2. Three panels representing nodes and ties.

Social networks are analyzed via social network analysis (SNA), a vast set of techniques that allow for the quantitative assessment of networks, including all of the quantities touched on in my earlier example (e.g., number of incoming [connections](#), number of outgoing [connections](#), number of reciprocated [connections](#), centrality in the network for each node), and much more (Kadushin, 2012; Valente, 2010). [Social network analysis](#) is the process of understanding social structures quantitatively through network theory and graph theory (Butts, 2008). A wide array of statistics can be derived from [SNA](#) – often called network statistics. Network statistics allow researchers to quantitatively measure all levels of a social structure (Krause, Croft, & James, 2007). Network statistics may be represented at the person-level or network-level. On a person-level, any single node may be analyzed in terms of its centrality (the number of incoming and/or outgoing [connections](#)). From here, we may evaluate whom has the most social capital in a network and what attributes (i.e. age, gender) are

related to having social capital. On the network-level, we are interested in the structure the network takes. Network density is one such network statistic that evaluates the whole network. Network density is the proportion of actualized network [connections](#) to the total possible number of [connections](#) (Giuffre, 2015). The denser the network, the more possible connections are formed. In my proposed study, I will utilize some, but not all, of these network statistics to answer my research questions.

Proposal

This study aims to quantify each mentee's connections with their primary mentor, with other mentors, and with mentees using [social network statistics](#), and then to study how these various connections with others in the program are related to the mentee's sense of belonging in the program and to their improvement in a set of key developmental outcomes (i.e., academic performance, depression, anger, and delinquent behaviors) over the course of the intervention. The reasoning for this approach is to understand which relationships matter most in group-based mentoring program for adolescents. I hypothesize that as youth's [connections](#) [grow](#) over the course of the intervention, their sense of belonging will also grow. However, the comparative effects of connections with each relevant party (primary mentor, other mentors, mentees) on growth in sense of belonging will be exploratory. Furthermore, I aim to expand our understanding of the most pertinent [connections](#) in a mentorship intervention by analyzing which types of [connections](#) (i.e. [connections](#) with the mentor vs. [connections](#) with other youth in the program) are most associated with improvement in the developmental outcomes, and the extent to which a sense of belonging in the program mediates the effect of social [connections](#) on improvement in these developmental outcomes.

For this thesis, I aim to answer the following research questions. My first research question is: Does [the number of connections developed with other individuals in the mentoring program correlate with a measure of belongingness](#)? Additionally, what type(s) of social [connections](#) (i.e., with the primary mentor, with other mentors, with other mentees) is the strongest indicator of belongingness in the program? I hypothesize that a youth's [strength of social connections](#) across time in a youth mentoring program will correlate highly with the change in [a measure of](#) belongingness. Next, for research question 2, I ask: Does belongingness mediate the effect of [the strength](#) of social [connections](#) on improvement in the developmental outcomes (i.e., academic performance, depression, anger, and delinquent behaviors)? Figure 1 presents my proposed mediation model. I hypothesize that the [stronger](#) connections a youth participant has, the higher their sense of belonging will be. This higher sense of belonging will be associated with improved developmental outcomes (i.e., increased academic performance, and decreased depression, anger, and delinquent behaviors).

Commented [H3]: This isn't specific enough. Could you say – Does the size of a mentee's social network correlate....
OR – more directly Does the number of social ties developed with other individuals in the mentoring program...

Commented [H4]: You talk about growth here – but not above – be consistent and specific.

CHAPTER II: METHOD

Study Protocol

Data for this project were collected from youth who participated in the Campus Connections (CC) mentoring intervention at Colorado State University (CSU). Campus Connections at CSU is a mentoring program for youth at heightened risk for poor developmental outcomes, such as behavioral and emotional problems. It is flexibly designed to respond to the needs of a heterogeneous group of youth with varying risk levels and is grounded in theoretical and empirical research on positive youth development (Eccles & Appleton Gootman, 2002; Kelly, Ryan, Altman, & Stelzner, 2000; Tseng & Seidman, 2007) and Rhodes' model of youth mentoring (J. E. Rhodes, 2005). See Haddock et al. (2013) and Weiler et al. (2015) for complete information on the program model.

At Campus Connections, youth are paired one-on-one with an undergraduate student who is enrolled in a 3-credit service-learning course for 12 weeks. The mentoring dyad meets four hours per week on campus and engages in a semi-structured program including “walk and talks,” academic support, dinner and other prosocial activities. Youth are constantly encouraged to engage in the mentoring community so they may gain a sense of belonging and mattering, develop social skills, and realize leadership skills. In addition, there are Marriage and Family Therapist (MFT) students and other trained staff around to help support youth and mentors. The MFT students and staff are trained to facilitate relationships between the mentors and mentees at CC.

Data were collected as part of a three-year grant funded by the William T. Grant (WTG) foundation to study two versions of a youth mentoring program. The study took place over the course of 6 semesters, from Fall [2015](#) to Spring [2018](#). The first version of the

program involved traditional dyadic mentoring, in which one mentor was assigned to one mentee to experience the 12-week program together. The second involved nesting 4 mentor-mentee pairs which were called mentor families. As a result, mentees were exposed to both a mentor of their own, as well as to 3 other mentor-mentee pairs in their mentor family over the course of the 12-week program. More information of the youth mentor family approach may be read in Haddock et al. (2013).

Campus Connections [took](#) place four nights per week (Monday – Thursday) during a regular academic semester (12 weeks), each mentee [was](#) assigned to one night. Approximately twenty-eight mentees were assigned to each night. Each semester, two of the nights were randomly assigned to the traditional dyadic mentoring condition ([control group](#)), and two of the nights were randomly assigned to the mentor family condition. Only the control group [was](#) utilized for the proposed study. This decision was made because the control group more accurately reflects most group mentoring programs. [It should be noted that although the mentee was assigned to a primary mentor, the intervention still took place in a group setting.](#) Thus, the results from my thesis will be more generalizable to other group mentoring programs.

Youth (mentees) were referred to the CC program through several community agencies including the local school district, juvenile justice system, Department of Human Services, and various youth and family agencies. Upon receipt of the referral, trained CC staff contacted potential participants and conducted intake appointments to determine program eligibility and obtain youth assent and parental consent. Study inclusion criteria included: Youth aged 11-18 years of age, reported experience of at least one risk factor from the risk screening tool (Herrera, Dubois, & Grossman, 2013), and available to participate during the CC operating hours.

Participants could not have participated in previous CC sessions to be eligible for this study. That is, over the course of the study, each adolescent participated in CC for a single semester.

Measures for Developmental Outcomes

In the proposed investigation, data were drawn from multiple time-points. If eligible and willing to participate in the CC program, mentees were invited to participate in 6 surveys during their time at CC. Surveys were administered at intake (Baseline; wave 0), week 1 (wave 1), week 3 (wave 2), week 6 (wave 3), week 9 (wave 4), and week 11 (wave 5) of the 12-week program. Surveys were completed using Qualtrics, an online survey platform. The Institutional Review Board at Colorado State University approved all the described procedures.

Commented [H5]: Would administered be a more appropriate word here?

Demographics

All youth demographics were collected at program intake (wave 0). Youth reported on their own primary demographic characteristics including age (11-18) and race/ethnicity. Parents reported child SES demographics (such as household income).

Social-emotional competencies

Social emotional competencies were reported by parents/guardians using the Devereux Student Strengths Assessment (DESSA; LeBuffe, Shapiro, & Naglieri, 2009) at program intake (wave 0). Each item on the DESSA asks parents/guardians to respond to an item regarding their youth's behavior in the past four weeks. The DESSA consists of 8 subscales with 72 items: Decision making (e.g., "Follow the advice of a trusted adult?"; $\alpha = .92$), goal-directed behavior (e.g., "Try to do her/his best?"; $\alpha = .92$), optimistic thinking (e.g., "Carry herself/himself with confidence?"; $\alpha = .87$), personal responsibility (e.g., "Serve an important role at home or school?"; $\alpha = .90$), relationship skills (e.g., "Compliment or congratulate somebody?"; $\alpha = .93$),

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[self-awareness \(e.g., “Show an awareness of her/his personal strengths?”; \$\alpha = .87\$ \), self-management \(e.g., “Pass up something he/she wanted now, to get something better in the future?”; \$\alpha = .91\$ \), and social awareness \(e.g., “Cope well with insults and mean comments?”; \$\alpha = .90\$ \). All items were rated on a 5-point scale \(1=never, 5=almost always\). Scores for each subscale were averaged across the respective items to create a composite score of social-emotional competencies \(\$\alpha = .97\$ at baseline\).](#)

Belongingness

Campus Connection mentees responded to a five-item scale that inquired about their sense of belongingness at CC via an adaption of the [Support and Opportunities Scale](#) (Alberti Gambone, Klem, & Connell, 2002). This measure was distributed at waves 1-5. At wave 1, youth participants were asked about their expectations to belong (i.e. “I feel like I will belong at Campus Connections”). For all other weeks, youth were asked about their present feelings of belongingness in the program (i.e. “I belong at Campus Connections”). Cronbach’s alpha was adequate at all five time points ($\alpha = .88 - .92$).

[*Strength of social connections*](#)

Youth were asked to indicate their relationships with other youth, mentors, and staff in the program during waves 1-5 of the program. Youth were shown pictures of other youth, mentors, and program staff within the program and were asked to select all that they had a relationship with. Youth were then asked to rate the relationship with each selected individual on a scale of 1 ([not very close](#)) to 10 ([very close](#)).

From these data the following individual network statistics will be calculated: *Inbound connections* and *outbound connections*. Inbound connections are connections that someone else

chose towards the individual of interest (the arrow points into the ego of interest). Specifically, the inbound connections score will be calculated as the sum of the strength of [connections](#) that other individuals indicate towards the person of interest. For example, if three individuals each indicated a connection with the individual of interest and each of those three [connections](#) had a strength of 5, then the total score for inbound [connections](#) will be 15.

Outbound connections are those that the individual of interest chose towards another individual (the arrow is pointing out of the ego). Specifically, the outbound connections score will be calculated as the sum of the strength of [connections](#) that the person of interest indicates towards other individuals in the program. For example, if the individual of interest indicated three [connections](#) outbound towards other people with a strength of 4 each, then the total score for outbound [connections](#) will be 12. We are also interested in the combination of inbound and outbound connections. This will be the sum of the inbound and outbound scores just described.

These inbound, outbound, and combined social [connections](#) scores will be constructed for three types of individuals based on the role of the alter: 1.) connections with other youth, 2.) connections with [the primary mentor and](#) other mentors in the program and 3.) connections with all youth, mentors, and staff in the program. Thus, nine scores that [summarize the strength of social connections](#) will be constructed for each mentee.

Delinquency

[The frequency of delinquent behaviors in the past month \(0-30 days\) was measured with 6 items \(e.g., "I damaged property that did not belong to me"; \$\alpha = .72, .85\$ at intake \[wave 0\] and week 11 \[wave 5\], respectively\).](#)

Academic aspirations

Commented [H6]: Are you doing anything with reciprocated ties?

Commented [Y7R6]: I was thinking no.... This is already a lot of analyses without them. However, if you think it is pertinent, then I will include them.

Commented [H8]: Where does connection with the primary mentor come into play? Does "other mentors" include the primary mentor?

Commented [Y9R8]: Yes

Mentees reported their academic aspirations with 3 items (e.g., “I plan to continue my education following high school”) using the Student Engagement Instrument (Appleton, Christenson, Kim, & Reschly, 2006; $\alpha = .88, .90$ at intake [wave 0] and week 11 [wave 5], respectively). Each item was rated on a 11-point rating scale (0=disagree, 10=agree).

Analysis Plan

All models will control for age, sex, ethnicity, SES (parent report) and youth social emotional competencies (parent report).

Analysis for Research Question 1

Latent growth modeling using Mplus, Version 8 (Muthén & Muthén, 1998) will be used to model the growth of belongingness and social ties across the five timepoints of CC. More specifically, a parallel processes growth model (one growth model for belonging and one growth model for social ties) will be specified. The model is depicted in Figure 3. The growth parameters within and cross process will be specified to correlate.

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Latent growth curve modeling is a method for capturing within-person change and between-person differences in within-person change (Grimm, Ram, & Hamagami, 2011). The simplest form of a growth model is a linear growth model. Here, variability in a set of repeated measures is captured by an intercept (i.e., predicted belongingness at week 1 – $i2$ in Figure 3) and a slope (i.e., rate of change in belongingness over the course of the intervention – $s2$ in Figure 3). These growth parameters are allowed to vary across individuals, capturing the extent to which participants differ in their level of belongingness at week 1 and the rate of change in belongingness over the course of the program. By specifying a growth model for the two processes of interest simultaneously, correlation of the growth parameters across process provide

information about how the processes relate to one another. The [cross-process](#) correlation of the slopes is of most importance, the correlation of the slopes (i.e., s_1 and s_2) will provide the degree to which growth in social ties is associated with growth in belongingness.

[For both growth models the time scores are fixed at 0, 1, 2, 3, and 4 to define a linear growth model with equidistant time points. The zero time score for the slope growth factor at time point one defines the intercept factors as initial status factors. The coefficients of the intercept growth factors are fixed at one as part of the growth model parameterization. The residuals variances are estimated and allowed to be different across time, and the residuals will not be correlated. For the parameterization of the growth model shown in Figure 3, the intercepts of the strength of social network connections and belongingness measure are fixed at zero. The means and variances of the intercept growth factors are estimated, and the intercept growth factor covariance is estimated because the intercept growth factors are independent variables. The slope growth factors are then correlated.](#) From here, I will compare all nine models to determine which relationship type (i.e. inbound/outbound relationships with other mentees, with the primary mentor, or other mentors/staff) is of most importance. This will be done by comparing the final correlational values and seeing which has the highest value and deemed the most important.

I cannot assume that the growth of the social network grows at a linear rate. Therefore, I will utilize a non-linear growth curve model known as a *latent basis growth model* as proposed by Grimm, Ram and Hamagami (2011). The latent basis growth model is flexibly designed to capture a variety of nonlinear change patterns because it does not have a specific functional form. This model allows for an atheoretical structure of change, thus allowing for the exploratory analysis I am searching for to answer this research question.

Commented [H10]: You need to say which factor loadings will be constrained. You also need to tell us that you will fit this for all of your measures of social ties – and if/how you will compare them to one another to determine which is most important.

Commented [Y11R10]: I am not totally sure I did this right... But I define all of this in the paragraph above. I mostly took the information from 6.13 in the Mplus handbook.

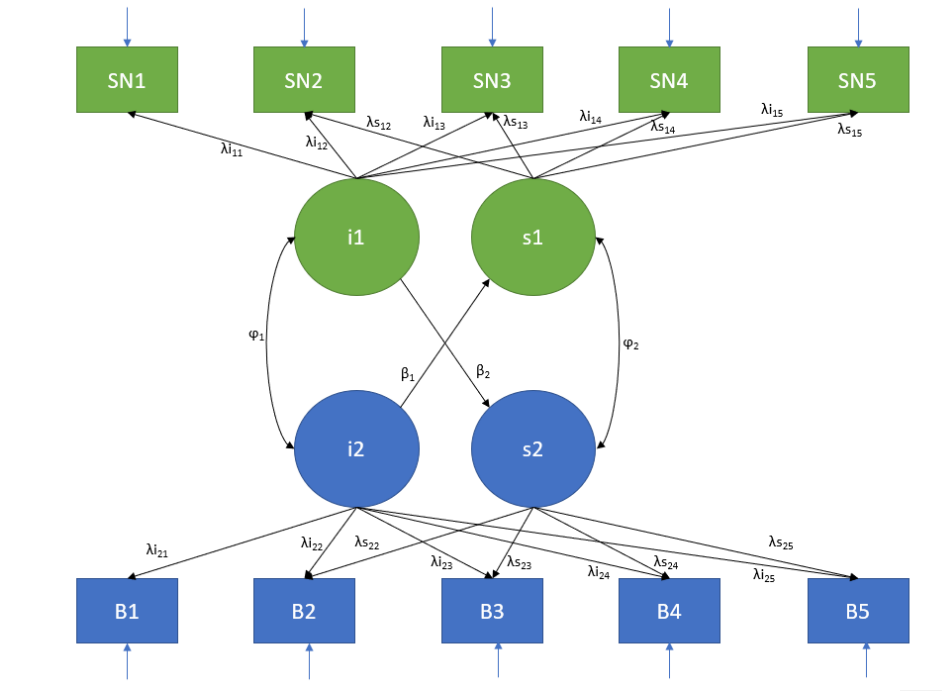


Figure 3. Anticipated growth trajectory model for trajectory analysis plan. SN = Strength of social connections; B = Belongingness measure, λ = factor loadings, φ = correlations, β = regressions.

Analysis for Research Question 2

Next, I will fit a mediation model with belongingness at week 9 (wave 4) as a mediator between the strength of connections (inbound, outbound, and inbound/outbound) between others (youth, mentors and staff) at week 6 (wave 3) and the developmental outcomes (i.e. academic aspirations, delinquency) at week 11 (wave 5). The proposed model is shown in Figure 1. To calculate this, I will first analyze the direct effect of social connections on the developmental outcomes (i.e. delinquency, academic aspirations; the c

Commented [H12]: Be specific – connections with whom, which measures, is it just one variable to represent ties or several variables...

path) at week 11 (wave 5). Next, I will regress belongingness from week 9 on the strength of connections (a path: inbound, outbound, inbound/outbound) at week 6 to estimate the a path of the mediation model. Then, I will regress the developmental outcomes (i.e. delinquency, academic aspirations) onto the strength of the social ties (inbound, outbound, inbound/outbound) and belongingness (b path and c' path). I will then multiply the a path and the b path to obtain the indirect effect. According to MacKinnon et al. (2007), the estimates for a mediation model's indirect effects are not distributed normally. Therefore, the bootstrapped confidence intervals for the indirect effect will be taken to determine more accurate confidence intervals and statistical significance. With this model, I aim to understand the impact belongingness has on developmental outcomes (i.e., academic performance, depression, anger, and delinquent behaviors).

Commented [H13]: I put a note in the last round that asked if this was the raw score or change score – please respond...

Commented [Y14R13]: Hmm, This is tough. I suppose I was thinking of it as the raw score. While controlling for baseline?

Commented [H15]: Look here – as an example of my prior comment – within a span of two sentences, you first call this “social connections” then “strength of social ties” – the reader is going to be confused. As a scientist – you have a duty to make your writing clear, concise, and easily digested by the reader. I spend hours and hours working getting my own writing into the best possible shape – it’s important that you also do this.

Commented [Y16R15]: I chose to go with “strength of connections”

Commented [H17]: Is it the confidence intervals that are the problem?

Commented [Y18R17]: The estimates are the problem?

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