

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.bbbso.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 aspirations, depression, anger, and delinquent behaviors). In this way, new insights into the types of relationships most salient for positive program outcomes may be discovered.

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 of prosocial behaviors and a setting the stage for 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 development 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 some negative behaviors (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 is associated with beneficial outcomes for youth, including 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, and more work to understand this phenomenon in group-based mentoring programs is needed.

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, Rostosky, & 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).

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, it is likely that a sense of belonging must be realized in order for a child to benefit from a group-based 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). Thus, belongingness is likely a key intermediate variable in a group-based mentoring program.

How then do participating adolescents form a sense of belonging in a group-based mentoring program? The feeling of belonging may be formed by social connections. Even a weak connection may be associated with a 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. In addition, Anderson-Butcher and colleagues demonstrate that belonging was associated with engagement in a youth program (Anderson-Butcher & Conroy, 2002).

For my thesis, I plan to examine belongingness as an important mediator between social connections 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 connections with other people in a group-based mentoring program 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-path*b-path) of social connections through belongingness. The c'-path will represent the direct effect of social connections on the developmental outcomes.

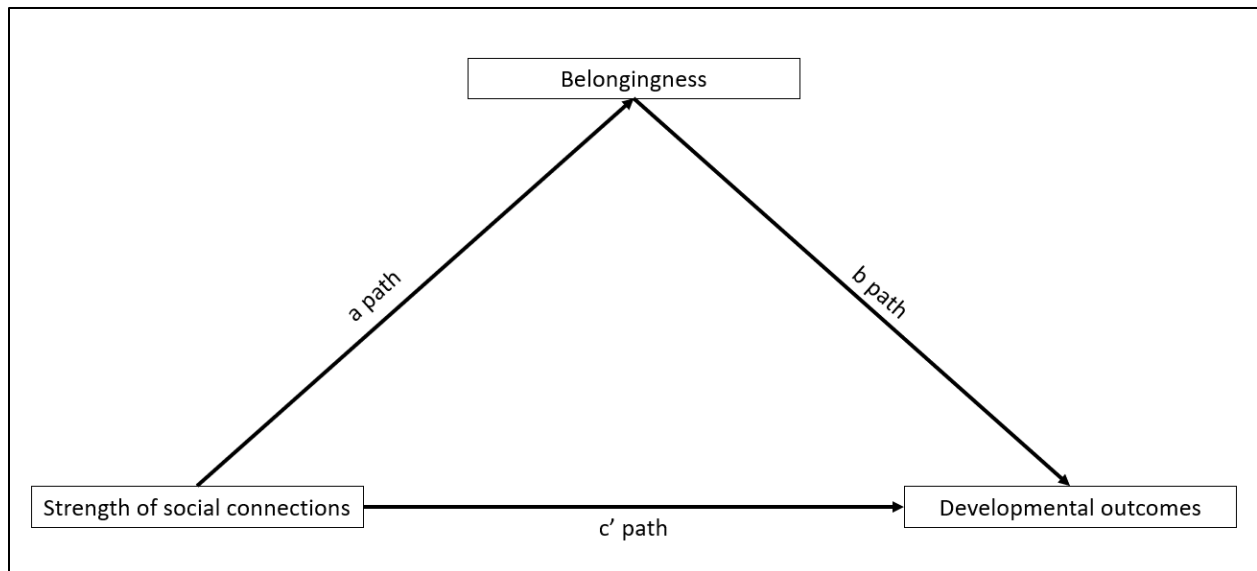


Figure 1. Proposed mediation model.

Social Networks

For this thesis, I will determine if strength of social connections in a group-based mentoring program lead to a sense of belonging, which will be a prime intermediate variable linking social connections to the key outcomes (i.e., academic aspirations, 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 will 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).

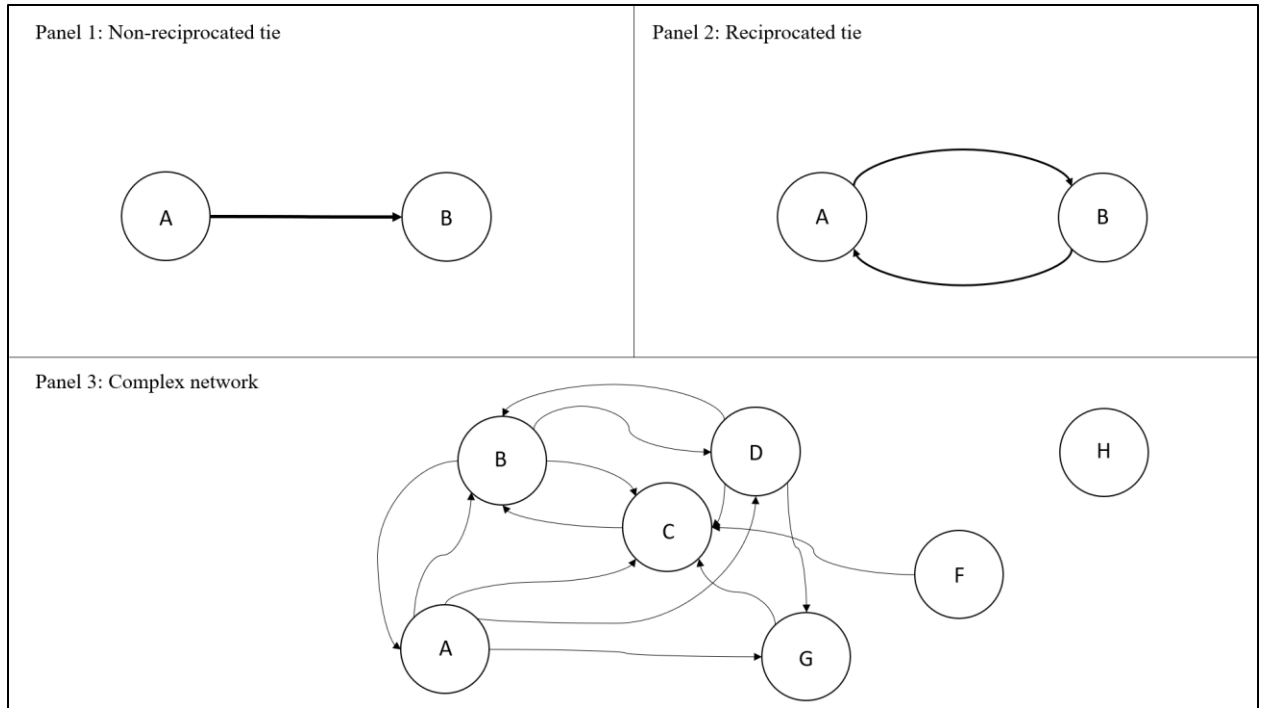


Figure 2. Three panels representing nodes and connections.

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 quantifying social structures 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 use several person-level network statistics to answer my research questions.

The Current Study

For this thesis, I aim to answer the following research questions. My first research question is: Does the number and strength 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/are the strongest indicator(s) 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 in the program. 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 aspirations, 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 in turn be associated with improved developmental outcomes (i.e., increased academic aspirations, and decreased depression, anger, and delinquent behaviors). While I hypothesize that, in general, stronger connections will be associated with a greater sense of belonging and improved developmental outcomes, the study of which type of connection (i.e.,

with the primary mentor, with other mentors, with other mentees) is associated with the best outcomes will be exploratory.

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. Each mentor-mentee pair experienced the program with approximately 28 other mentor-mentee pairs assigned to the same night. The second involved nesting 4 mentor-mentee pairs in a mentor family. The mentor family participated in each component of the program together. As a result, mentees were purposefully exposed to both a mentor of their own, as well as to 3 other mentor-mentee pairs in their mentor family. Each night, there were between 6 and 8 mentor families who participated. 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 (experimental group). Only the control group was utilized for the proposed thesis. 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, and mentees had the opportunity to get to know other mentees and mentors in the program. 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.

In order to examine the effects of the intervention, mentees, mentors, and the mentees' parent/guardian completed a series of web-based surveys. Mentees and mentors 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. Each mentee's parent or guardian was invited to participate in a survey at baseline and at the end 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.

Primary Measures

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 0-5. At wave 0, 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 *friendship* with. Youth were then asked to rate *how close* they felt with each selected individual on a scale of 0 (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.

These inbound, outbound, and combined (inbound + outbound) social connections scores will be constructed for three types of individuals based on the role of the alter: 1.) connections with other youth, 2.) connection with the primary mentor, 3.) connections with other mentors 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

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).

Depression

Depression was measured with 9 items (e.g., “I was tired all the time”) using the revised Center for Epidemiologic Studies Depression Scale (CESDR-10; Haroz & Ybarra, 2014; $\alpha = .89, .91$ at intake [wave 0] and week 11 [wave 5], respectively). Mentee answered the frequency of their symptoms in the past week (range= 0-7 days).

Anger

Anger was measured with 3 items (e.g., “I get mad”) from the Brief Anger Scale (Deffenbacher, Oetting, Lynch, & Morris, 1996; $\alpha = .93, .94$ at intake [wave 0] and week 11 [wave 5], respectively). Each item was rated on a 11-point scale (0=never, 10=all of the time).

Control Measures

Demographics

All youth demographics were collected at program intake (wave 0). Youth reported on their own primary demographic characteristics including age (i.e. 11-18), sex (i.e. 1 = Male, 2 = Female), and race/ethnicity (i.e. 1 = American Indian, 2 = Asian, 3 = Black, 4 = Hispanic, 5 =

Hawaiian, 6 = White, 7 = Mixed). Sex and race will be included as dummy coded variables. The parent/guardian reported child household income (i.e. 1 = Less than \$20,000, 2 = \$20,000 to \$39,999, 3 = \$40,000 to \$59,999, 4 = \$60,000 to \$79,999, 5 = \$80,000 to \$99,999, 6 = \$100,000 or more)

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?"; $\alpha = .93$), 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).

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 connections across the five timepoints of CC. More specifically, a parallel processes growth model (one growth model for belonging and one growth model for social connections) will be specified. The model is depicted in Figure 3. The growth parameters within and cross process will be specified to correlate. Growth parameters of each process will be regressed on age, sex, ethnicity, SES, and social emotional competencies.

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 – i_2 in Figure 3) and a slope (i.e., rate of change in belongingness over the course of the intervention – s_2 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 in the current investigation, the correlation of the slopes (i.e., s_1 and s_2) will provide the degree to which growth in social connections is associated with growth in belongingness.

For both growth models the factor loadings for the slope growth parameter may be 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 then 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 for the repeated measures will be estimated and allowed to be different across time, and the time-specific residuals will not be correlated by default.

I cannot assume that the growth of social connections and belonging will follow a linear process. Therefore, I will consider a series of functional forms for the growth processes and select the best-fitting form. I hypothesize that a *latent basis growth model*, as proposed by Grimm, Ram and Hamagami (2011), may provide the best fit. 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. According to Grimm, Ram and Hamagami (2011), a latent basis growth model can be written as:

$$y_{nt} = i_n + s_n \cdot (\alpha_t) + e_{nt}$$

y_{nt} represents the repeated measures of attribute y (strength of social connections or belongingness) of individual n at time t , α_t are basis coefficients that represent how the within-person change process unfolds, i_n is the intercept for individual n when $\alpha_t=0$, s_n is the shape factor for the predicted change in y for a one unit change in α_t for an individual n at time t . With this, I will place model constraints on α_t as to define s_n . For example, I may constrain α_1 to 0 and α_5 to 1, thus making i_n interpreted as an individual's predicted score at $t = 1$ and s_n as the total amount of change that occurred from $t = 1$ to $t = 5$. This model allows for an atheoretical structure of change, thus allowing for the exploratory analysis I am searching for to answer this research question.

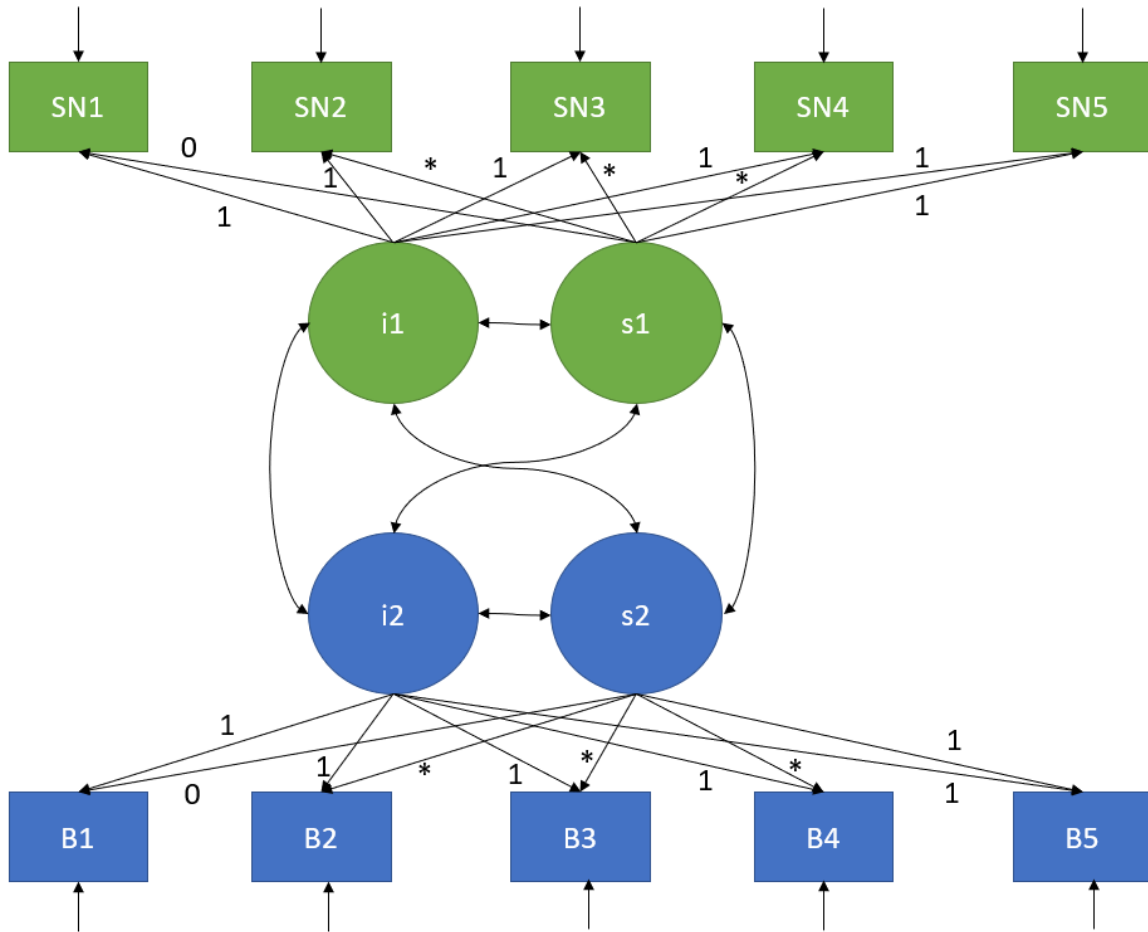


Figure 3. Anticipated growth trajectory model for trajectory analysis plan. SN = Strength of social connections; B = Belongingness measure.

I will fit this dual trajectory model nine times, once for each of my social connection measures to determine which relationship type (i.e. strength of connections with other mentees, with the primary mentor, and with all other mentors) and direction of relationship (inbound/outbound/total) is of most importance. I will use two methods to determine which social connection measure is most important. First, I will compare the Akaike Information Criterion (AIC) values across all nine models. The models with lower AIC values will be deemed better fitting models. Secondly, I will compare the unstandardized and standardized

estimate of the covariation/correlation between the slopes of the two growth models (connections and belonging) obtained from all nine dual growth trajectory models. A stronger covariation/correlation between the slopes of belongingness and the strength of social connections will be indicative of a stronger relationship between the two processes.

Analysis for Research Question 2

Next, I will fit a series of mediation models with belongingness at week 9 (wave 4) as a mediator between the strength of connections (inbound, outbound, and inbound/outbound) for relationship with the other mentees, the primary mentor, and with other mentors at week 6 (wave 3) and the developmental outcomes (i.e. academic aspirations, delinquency) at week 11 (wave 5). This will make for a total of nine mediation models. All mediation models will be fit using R, version 4.0.2 (R Core Team, 2020). 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-path) entered in at week 11 (wave 5) while controlling for age, sex, ethnicity, SES, and social emotional competencies. The dependent variables (i.e. academic aspirations, depression, anger, and delinquent behaviors) will be calculated as difference (change scores) from baseline to week 11 (i.e., week 11 score – baseline score). The decision to use difference scores was made because, according to Castro-Schilo & Grimm (2018), using the difference scores approach may lead to less bias and be more likely to have a causal interpretation in this observational study. 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 while controlling for age, sex, ethnicity, SES, and social emotional competencies. Then, I will regress the developmental outcomes (i.e.

delinquency, academic aspirations) onto the strength of the social connections (inbound, outbound, inbound/outbound) and belongingness (b-path and c'-path) while controlling for age, sex, ethnicity, SES, and social emotional competencies. I will then multiply the a-path and the b-path to obtain the indirect effect. According to MacKinnon et al. (2007), the sampling distribution of the indirect effects are typically not distributed normally. Therefore, bootstrapped confidence intervals for the indirect effect will be calculated and used for determining statistical significance. With this model, I aim to determine if the effect of social connections on change in the developmental outcomes (i.e., academic aspirations, depression, anger, and delinquent behaviors) is mediated by belongingness.

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