**Succinct review of prior work**

Prior evidence suggests that youth who report higher belonging in a program are more likely to have more expressed satisfaction with their relationships (Marsh, 2009). Baunmeister & Leary (1995) have discussed the importance of belongingness during the adolescent time period and explain that it is a fundamental part of forming relationships with adolescent peers. Additionally, promoting positive social bonds between youth is an essential component to reducing delinquent behavior (Hirschi, 2002). Bond et al (2007) found that having good social and school connectedness were both associated with better outcomes within adolescents. However, McNeely & Falci (2004) found inconsistent results with social belongingness in school. McNeely & Falci (2004) found that, although belonging in adolescent peer groups may be high, this may not be protective against health-risk behaviors. Based on the differences in results reported in the literature, it is important to look at both a youth’s feeling of belongingness and the social bonds they form while participating in a social program focused on building positive friendships between adolescent peers. Understanding the connection between these two social constructs can help to further establish the meaning of belongingness within an adolescent peer setting.

A method most often times lacking in understanding an adolescent’s sense of belonging to a school or program is its association with the connections the adolescent may have with others in the school or program. This study aims to utilize a social network approach to understanding how an individual’s sense of belonging is associated with their embeddedness within the program. Within the social network, the concept of social capital and the relation with health outcomes is also of great interest to the research community and has been used in several research articles (Barman-Adhikari & Rice, 2014; Szreter & Woolcock, 2004). The use of understanding an adolescent’s social network is popularized in the understanding of substance use within understanding the adolescent peer groups (Ennett et al, 2008; Valente, 2003). Additionally, several network studies on teen groups emphasize the importance of one aspect specifically: *Position in the network* (Alexander et al, 2001; Ennett & baumann, 1993). Therefore, this study aims to utilize the network statistics towards an advantage to later understand how belongingness may serve as a tool to understand an individual’s network to later better understand other adolescent outcomes. However, defining what is considered an advantageous part of the network is of great debate and is often defined based on the research questions at hand.

**Importance of Centrality as a place in the network**

To start, a quote by Freeman:

“A person located in the center of a star is universally assumed to be structurally more central than any other person in any other position in any other network of similar size.” (Freeman (1979), p. 218)

For the purpose of this study, a large emphasis will be laid on an actor’s (in this case an adolescent) centrality within the program. On its basic level, centrality is related to the number of connections an individual has within a social network. It can be defined through inbound connections (an indicator of popularity) and outbound connections (an indicator of gregariousness) or a combination of both (betweeness). Unfortunately, the understanding of centrality within a network cannot be taken so lightly, as there are many social network processes that play a role in the number of connections when defining the entire network that an individual is immersed in.

The concept of centrality within a social network was originally introduced in Bevales in 1948. However since being heavily discussed, the ability to truly identify centrality’s importance within the role of outcomes and individuals actors within a network has been discussed heavily within various literature (Cohen, 1964; Shaw, 1964; Burgess, 1968; Snadowsky, 1972). Several indicators and types of centrality have been proposed throughout time (Freeman, 1978; Newman, 2001; Opsahl, Agneesens & Skvoretz, 2010). All of these centrality indicators are used for different scenarios when defining a network or understanding an ego’s role within a network. Although its actual implications have been of heated discussion, one thing is clear, it is an important aspect to the actor’s position within a network (Freeman, 1978).

Based on the number of readings on centrality and the number of different definitions, two forms of centrality that are of particular interest to the current study are Eigenvector centrality (Bonchiach, 1972) which has been used in Friendship networks and Betweeness Centrality (Freeman, 1977). Eigenvector centrality is a much popularized centrality technique in the literature that incorporates an actor’s degree centrality (inbound and outbound relationships) as well as taking into account the centrality of the others within the actors surrounding network. The emphasis in the eigenvector centrality measure that an individual’s popularity within a network can be further accounted for by the popularity of those they are surrounded by. Betweeness centrality, on the other hand, corresponds to the number of times an individual falls on the shortest path from one actor to another. Both representations of centrality are discussed in greater detail in their corresponding articles, including the strengths and limitations of each. For the purpose of this study, Eigenvector centrality seems to be the most appropriate method; however, the betweeness of each individual should be assessed to some degree as well. Lastly, Using the Euclidian normalization techniques discussed in Papendiech & Recht’s (2000) article we can discount network size and get a better understanding of an actor’s centrality within any network (with techniques available in the “sna” package in R).

Campus Connections has the unique aspect of being a controlled environment in which adolescent peers have the chance to interact with one another once a week with the presence of paired mentors and trained program staff. Additionally, a wide variety of youth and adults serve in the program, offering a diverse population to study. The environment is monitored and controlled very tightly and social interactions between youth peers and other adults in the program are highly encouraged through prosocial activities and staff engagement. By measuring the changing social networks throughout the course of the 12-week program we are able to track the youth’s social capital and see its relationship with program belongingness.

**Approach**

**Data Collection**

The Campus Connections Program (CC) has collected data using a measure of belongingness (Youth Development Strategies, Inc.) that was assessed prior to Campus Connections (Baseline) and assessed program belongingness in the *future* (i.e. I feel like I will belong at Campus Connections). The social network at week 1 was assessed by the same fashion.Next, it was assessed in the present tense at all other survey time points during the 12 week program (weeks 3, 6, 9, & 11). At the same rate that the growing social network was assessed, which mentees had the ability to choose all individuals within the program and assessed their overall relationship with others. Again, the social network was assessed in the present tense at all of these time points as well.

**Scope of the project**

For the current study the researchers will be analyzing the evolution of the social network by tracking important social network measure (the earlier specified centrality measures) and reciprocity and incorporating them into a predictive linear regression model. The outcome variable will be the belongingness scale. The predictor variable will be the social network measures. We will assess the social network and sense of belonging at all weeks (1, 3, 6, 9, & 11). At the same time we will be controlling for common characteristics that would confound an adolescent’s sense of belonging. Some of these factors include common adolescent demographic factors. Additionally, I feel an individual’s initial depression score may serve as a confounder as this both affects and individuals ability to build relationships/connections within the program as well as an individuals to feel belonging within a program. Therefore, Baseline CES-D score will be controlled for in the context of this study.

**Goals**

A major goal of this research project is to track and analyze the changing social network for the youth and analyze their social capital and understand its relationship with program belongingness. Using the belonging measure, adapted by *Youth Development Strategies, inc* the goal is understand if this concept of social capital within the campus connections has a relationship to belongingness. By tracking the change in the social network and a mentees sense of belongingness across the week 11 program we can see that the impact of an individual’s social network and centrality can be an indicator of program belongingness. As belongingness and the social network are measured at the same time points, the goal is to understand how they relate with another. Additionally, to see if the measure of belongingness changes as a mentees relationship structure within the network changes as well.

The point in this project is to understand how this belongingness measures related to an individual social embeddedness in the program. It will be interesting to utilize the fact that we have both social network data as well as these measures tracked throughout the program so we can see how related they are with each other.

**Analysis Method**

Using multivariate regression, I plan to use our validated measure scores (belongingness) as the outcome variables. Next, while controlling for several important demographic variables, such as age, ethnicity, sex, and other important variables, we can assess how a mentees embeddedness in the program, or in other words, a mentees social capital, using measures controlled measures of centrality as well as their reciprocity with others in the program as our predictor variables. Because Belongingness is measured at all 5 survey time points in the program, along with the social network, we can analyze and understand how they evolve with each other at the survey time points.

It is important to use standardized measures of centrality that control for multiple aspects of the social network of the program. As mentioned before, a centrality measure of interest is the Eigenvector centrality measure. Additionally, Betweeness centrality may be of interest as well. Using the SNA package in R we are able to obtain these values for all mentees within the program. The eigenvector centrality measure is standardized measure that understands how others are connected within the program based on both their centrality score as well as others around them. Therefore, the Eigenvector centrality score takes into account the individuals inbound and outbound connections while also taking into account the centrality of scores of those around them. This is a form of understanding an individual’s embeddedness in the program, as well as how well they are connected to other popular individuals in the program. A higher Eigenvector Centrality score is associated with better social capital and more social embeddedness within the program. It is also appropriate to measure just the individual mentees eigenvector with other mentees in the program, and assess their social capital within the entire network [we can control for this by attaching nodal attributes using the ‘infocent’ command in the SNA package](Butts, 2010). Thus allowing us to create Hierarchical models in predicting program belongingness.

It is also important to understand an individual’s reciprocity within the network. For the purpose of this study, we need to make a decision on how to handle the weighted network in terms of viewing reciprocity. There are methods available in order to properly symmetrize networks within the sna packages in R (Butts, 2010). Squartini et al. (2013) have a report indicating the limitations in symmetrizing a reciprocated network. However, it appears that, although there are limitations, it is important to use the higher weighted value when there are differences in the reciprocity scores between two actors (i.e. if there is a tie of 2 and a tie of 5 being reciprocated, it is better to take the higher value of 5 to indicate the strength of reciprocity between actors). Of course, analyzing the reciprocity at the unweighted level is also a possibility to be taken into account.

**Research questions**

Using these analysis methods, the following research questions can be formed:

1. How is a mentees embeddedness in the Campus Connections associated with their feelings of belongings in the program?
   1. Is the network embeddedness in the Campus Connections program a predicted by a mentees feeling of belongingness within the program?

**Hypotheses:**

* + - 1. Youth that are more embedded (measured through special measures of centrality) in the social network are more likely to have a better sense of belonging in the Campus Connections program.

**Potential Journal submissions:**

1. **Journal of Research on Adolescence:** <http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1532-7795>
2. **Social Networks:** <https://www.journals.elsevier.com/social-networks/>
3. **International Journal of Behavioral Development:** <http://journals.sagepub.com/home/jbd>

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