Running Head: ADOLESCENTS' PEER GROUP PERCEPTION

Adolescents' Perception of Peer Groups:

Psychological, Behavioral, and Relational Determinants

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Abstract

Adolescents' social cognitive understanding of their social world is often inaccurate and biased. Focusing on peer groups, this study examines how adolescents' psychological, behavioral, and relational characteristics influence the extent to which they accurately identify their own and others' peer groups. Analyses were conducted with a sample of 1,481 seventh- and tenth-grade Chinese students who are embedded with 346 peer groups. Overall, females and older students had more accurate perceptions. In addition, lower self-esteem, higher indegree centrality, and lower betweenness centrality in the friendship network predicted more accurate perception of one's own groups, whereas higher academic performance and lower betweenness centrality in the friendship network predicted more accurate perception of others' groups. Implications for understanding the connection between adolescents' psychological and behavioral traits, social relationships, and social cognition are discussed.

Keywords: perception accuracy; adolescent; peer group; friendship network; Social Cognitive Mapping; Social Network Analysis

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1. Introduction

How individuals perceive their surrounding social network structure has been an important concern in the networks literature. Studies have focused on examining individuals' recall of dyadic ties among members in their group, primarily from the Cognitive Social Structures (CSS) perspective (Brands, 2013; Krackhardt, 1987). Two major questions have been studied: first, how perceptions of network ties are related to individual traits as well as structural positions (e.g., Bondonio, 1998), and second, how accurate perception impacts outcomes such as effective organizational performance (e.g., Casciaro, Carley, & Krackhardt, 1999; Krackhardt & Hanson, 1993).

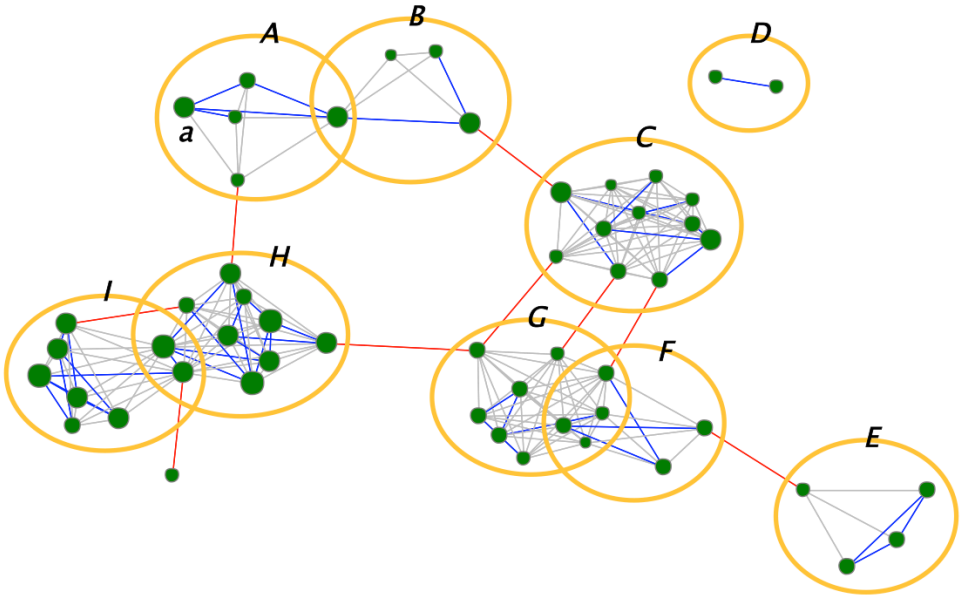
The current study addresses the questions pertaining to network perception in a population of Chinese adolescents. Children's social cognitive ability is related to their social functioning (Selman, 2003) and in particular, being able to perceive the structure of their social surroundings has important implications for adolescents' psychological and behavioral outcomes (Andreassi, 2004). Yet, adolescents' recall of social relationships is often biased (Cairns, Xie, & Leung, 1998; Farmer & Xie, 2013; Leung, 1996). Perceptual bias has been identified in terms of viewing one's own network position (Neal & Cappella, 2014) and level of social acceptance (Brendgen, Vitaro, Turgeon, Poulin, & Wanner, 2004; Zakriski & Coie, 1996) as well as appraising the characteristics of the overall classroom network (Cappella, Neal, & Sahu, 2012).

This study focuses on peer group structure. The desire to belong to a valued social group is a key aspect of identity development in adolescence (Kroger, 2000; Tanti, Stukas, Halloran, & Foddy, 2011; Tarrant et al., 2001). Peer groups exert substantial influence on adolescents (Fletcher, 2012; Guo, Elder, Cai, & Hamilton, 2009; Ueno, 2010; Vásquez, 2010), and how

adolescents perceive these peer groups can influence their desire to belong to a given group or to interact with certain members of a group. Furthermore, given that perception is an underlying asset for social capital (Brands, 2013; Burt & Ronchi, 2007), adolescents who are able to accurately perceive the relationships they are surrounded by may be able to better mobilize resources to take advantage of their network. Despite the importance of peer group perception, not much is known about what explains adolescents' accurate or biased perception of peer groups. We suggest that adolescents' psychological, behavioral, or relational characteristics will correlate with their ability to accurately perceive peer groups. If such systematic relationships exist, certain people may be privileged with network advantage from having a better understanding of their social environment. In other words, while literature on social capital emphasizes resources that can be reaped from the social relations and structure one is embedded in (e.g., Bourdieu, 1986; Burt, 2004), an individual's cognitive perception of the social relations and structure around them could constrain their ability to benefit from social capital.

We focus on cognitive accuracy (Krackhardt, 1990), which is reflected in the extent to which a student's cognitive map converges with those of other students in the classroom. In particular, we distinguish between adolescents' accuracy with respect to peer groups in which the individual is a member (see Figure 1: node *a*'s perception of peer group *A*) and those groups that do not include the individual (node *a*'s perception of all other peer groups, *B* - *I*). Social identity theory and self-categorisation theory (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) suggest that perception of ingroups and outgroups is related to adolescents' self-concept and self-esteem (Tanti et al., 2011). This study examines how perception of these ingroups and outgroups may be explained by individuals' psychological and behavioral traits as well as their social relationships.

Figure 1. Friendship and peer groups in a classroom setting



Note. Small green circles are students in a classroom, sized by their degree centrality in the friendship network. Large yellow circles and grey lines within the circles indicate peer groups identified by the Social Cognitive Mapping (SCM) procedure. Blue and red lines indicate dyadic friendship ties identified based on sociometric nomination. Blue lines are friendship ties that exist within peer groups. Red lines are friendship ties that exist across different peer groups.

2. Background and significance

2.1. Peer groups and friendships in adolescence

Social influence occurs not only within friendship dyads but also in larger social groups, and children's experiences in these groups are important. Adolescents seek a sense of belonging, and feel isolation when they are not included in peer groups (Tarrant et al., 2001; Ueno, 2005). Examination of these social groups allows us to understand various aspects of social ecology such as leadership, status, popularity, rejection, and group influence (see Cairns et al., 1998 for a review). Examining peer groups vis-a-vis friendship has been a focus of research, in particular in asking how dyadic friendships overlap with or diverge from larger group structures (Cairns, Leung, Buchanan, & Cairns, 1995; Kindermann, 2007). Overall, these studies suggest that peer groups and friendships are different types of relationships, and peer groups involve unique

dynamics and are an important driver of social identity formation and social influence for adolescents.

Two major approaches have been used to identify children's groups. First, groups can be derived from self-reported friendship ties. Groups are identified via graph algorithms (see Moody, 2001 for a review), generally focused on finding a set of people that have more ties within the members of the group than with those outside of the group (e.g., Borgatti, Everett, & Freeman, 2002; Frank, 1995). An alternative approach is to ask respondents to identify the groups that they perceive to exist and to list the members of these groups (Gest, Moody, & Rulison, 2007; Kreager, Rulison, & Moody, 2011). A widely used method for accomplishing this is the social cognitive mapping (SCM) technique developed by Cairns and his colleagues (Cairns, Gariépy, & Kindermann, 1990; Kindermann, 1998). Using this method, respondents are first asked about the membership of the group within which they are a member, and then to identify the membership of up to five other groups. SCM places emphasis on identifying groups of individuals who interact and spend time together rather than identifying groups based on dyadic friendship ties (e.g., Pollard, Tucker, Green, Kennedy, & Go, 2010).

Since a majority of social network analysis (SNA) studies rely on self-reports, accuracy of network perception has been an important concern. Starting from the classic studies (e.g., Bernard & Killworth, 1977; Bernard, Killworth, & Sailer, 1979, 1982; Freeman, Romney, & Freeman, 1987) that compared individuals' recall against actual observation of behavioral interaction, researchers have emphasized that individuals' perception of networks is often inaccurate and biased. With the introduction of the CSS approach (Krackhardt, 1987), a stream of research examined the extent to which individuals' recall converges with the perception of others in the same social group or organization (e.g., Bondonio, 1998).

We adopt the latter perspective and define perception accuracy as the extent to which

groups named by a student converge with the final groups derived by the SCM procedure. Although there is no uncontestable "truth" about which students are in which groups, SCM is designed to capture the full community's consensus perception about groups.[1] Such aggregated perception has been considered as an "actual structure" (Bondonio, 1998, p. 303) or "underlying truth" (Krackhardt, 1987, p. 118) against which individual reports are compared. We use this consensus perception even for measuring the accuracy of how children perceive their own groups, because it is difficult to be confident about group boundaries when only using information from the few participants who claim to be in the group.

2.2. Predictors of adolescents' perception of peer groups

Adolescents' reports of groups may not be accurate for numerous reasons (Farmer & Xie, 2013). For example, groups often underrepresent their membership, whereby adolescents fail to report all the members of groups that were identified using the consensus of peers (Cairns et al., 1995). One possibility is that members are affected by self-enhancement biases whereby they omit members with unfavorable characteristics such as low grades or low interpersonal competence (Leung, 1996). While such *patterns* of inaccuracy have been studied, little is known about the *predictors* of accuracy in perceiving peer groups. In addition, while the role of demographic and relational correlates of perception accuracy has been studied more extensively (e.g., Brashears, Hoagland, & Quintane, 2016; Neal, Neal, & Cappella, 2016), the relationships between perception and psychological and behavioral traits of adolescents have received little attention. We draw from literature on adults' perception accuracy as well as accuracy of recall in the context of dyadic friendship ties to examine adolescents' perception of peer groups. In the

[1] The SCM procedure that we used aggregates the reports of all classmates with a minimum of two respondents required to indicate that someone is a member of a group before that individual is identified as a member. This controls for the possibility that children could be identified as a group member based solely on their self-report.

Chinese context we are examining in this study, perception of peer groups is particularly relevant because collectivistic societies emphasize the role of group affiliation in the social, academic, and psychological adjustment of children and adolescents (Chen, Wang, & Cao, 2011).

This study examines adolescents' perception of peer groups in two different contexts: perception of their own group (which involves the self) and others' groups (which does not involve the self). As to the perception of one's own peer group, based on social identity theory, we can expect that people will be more attentive to their ingroup if their peer group is an important aspect of their identity. Further, certain psychological or social traits can influence people to hold more or less accurate perception of their ingroup members. In the case of perceiving other peer groups that do not involve the individual, those who are more cognitively attentive to their environment are expected to have a more accurate perception. Individuals often have little direct knowledge of many of the groups that exist and consequently rely upon environmental cues (Neal, Neal, & Cappella, 2014).

Within the broader SNA literature, both individual factors such as psychological or behavioral attributes and relational factors such as an individual's network structural position have been found to predict network perception (Casciaro, 1998). In terms of psychological traits, Casciaro et al. (1999) found that low self-esteem is associated with more local accuracy (i.e., accuracy in perceiving one's personal ties) while high self-esteem is associated with more global accuracy (i.e., accuracy in perceiving ties linking all respondents to each other). In addition, high self-monitoring has been associated with higher accuracy (Flynn, Reagans, Amanatullah, & Ames, 2006). Other personality traits such as need for achievement, need for affiliation, and extraversion have been found to be associated with network perception accuracy, while the direction of the association depends on the type of network ties, such as whether they are friendship or advice ties (Casciaro, 1998).

Studies of adolescents reveal that social isolation and perception can be related in two ways. First, those who are psychologically isolated may be more realistic about their standing. Rudolph and Clark (2001) found that children with depressive symptoms tended to hold more negative views of both self and peers than did non-depressed children, in part suggesting that they are "sensitive to social cues and incorporate feedback from the environment into their social perceptions" (p. 52). Second, isolated students' weak connections to other people in the group may reduce their opportunity to understand the social structure in the environment because by definition they have fewer interactions and thus have limited opportunity to glean information from others. In a study with third and fourth grade Chinese students, loneliness was associated with lower self-perceived social competence and friendship quality (Zhou, Zhao, Sun, & Ding, 2006). To further elaborate on these potential predictors of perception bias in Chinese adolescents, we examine *how adolescents' psychological traits – self-esteem and loneliness – are associated with accuracy in perceiving (a) one's own peer group and (b) others' peer groups (RQ1*).

We also examine whether there are behavioral attributes that can explain adolescents' accuracy of perception. First, academic performance is likely to be associated with the extent to which a student can perceive networks accurately. Little research on academically competent youth has examined their perceptions of peer networks, but there is some evidence that suggests that academic intelligence relates to social memory, which is an ability to store and recall social information (Conzelmann, Weis, & Süß, 2013). Conzelmann et al. also showed that academic intelligence was related to some social perception tasks such as detecting and understanding socially relevant information. Boor-Klip, Cillessen, and van Hell (2014) suggested that high-ability children are more accurate than others in their social understandings such as perceiving acceptance and rejection. There is also evidence that high achieving Chinese children tend to be

socially competent and well connected with peers (Chen, Rubin, & Li, 1997). Their study does not directly address the issue of perceptions but from information processing perspective (Bondonio, 1998), those who are well connected with peers are assumed to have a larger amount of information exchange with others, thus there will be a higher likelihood that their perception matches that of the majority of others.

Second, studies have linked aggression with network perception. Neal and Cappella (2014) found that aggressive children display low accuracy in perceiving their own groups, in particular by underestimating the number of peers they interact with. On the other hand, Mayeux and Cillessen (2008) found that individuals who were popular and aware of their popularity exhibited more aggression than individuals who had less accurate perceptions of their standings. Whether these perception tendencies apply to the context of perceiving others' peer groups has not been examined. One possibility is that aggressive children are attuned to the social status of others as this information is relevant to their selection of appropriate victims. Or alternatively, those who are knowledgeable of peer groups may be able to use aggression as a tool, particularly in terms of engaging in relational aggression. Faris and Ennett (2012) found that adolescents who are highly concerned with their status are more likely to become aggressive, supporting the possibility that these children are more likely to pay attention to the social structure surrounding them. Sutton, Smith, and Swettenham (1999) challenged the idea that most aggressive behavior may be a result of poor social understanding. In a study of teacher-reported bullies, 'follower' bullies (those who supported the bully), and victims, they found that aggressive participants were better than either follower bullies or victims at understanding the cognitions and emotions of others. There is evidence that aggressive children in China may experience various adjustment problems including peer rejection, low social competence, and depression, but their accuracy with respect to social understanding has not been studied (Chen, Rubin, & Li, 1995). In this

study, we examine *how adolescents' behavioral traits – academic performance and aggressive behavior – are associated with accuracy in perceiving (a) one's own peer group and (b) others' peer groups (RQ2).*

Perception accuracy may also vary as a function of the individuals' relationships with others and of their membership and status within groups. Findings vary across studies. Krackhardt (1992) and Casciaro (1998) found that an individual's centrality in their friendship networks was associated with an accurate perception of the friendship network, explaining that the larger the number of friends, the more one can receive information about informal relationships. Bondonio (1998) found that overall indegree centrality in the friendship or advice network was linked with greater accuracy of perceiving informal social networks. On the other hand, Simpson, Markovsky, and Steketee (2011a, 2011b) suggested that individuals with low positional power have more accurate network knowledge because they engage in more scrutiny of others' social relations.

While degree centrality refers to the number of friends, betweenness centrality measures the extent to which an individual falls between pairs of other individuals (Freeman, 1979). People with high betweenness centrality occupy brokerage positions. They are in contact with multiple different social circles and have better visibility: they are able to "see early" and "see more broadly" (Burt, 2004, p. 354). According to this perspective, people with high betweenness may be able to perceive social relationships more accurately. However, past studies on perception have not found significant associations between betweenness centrality and cognitive accuracy (Krackhardt, 1987, 1990) and explain that degree centrality best captures the amount of information exchange with others and the potential for more accurate perception of social relationships (Bondonio, 1998; Casciaro, 1998).

In the adolescent context, studies have shown how socially rejected children in

comparison to popular children perceive their social context. Children's social perceptions rely on the type of interactions they have with others, and rejected children are typically accurate in perceiving who dislikes them, but have inaccurate perceptions about who liked them (Cillessen & Bellmore, 1999; MacDonald & Cohen, 1995). Unpopular students are often excluded from social feedback, and their views about themselves and about their peers are less frequently tested in interactions (Cillessen & Bellmore, 1999), while they are likely to be more frequently engaged in negative peer interactions which allow them to be aware of who has negative opinions of them. In this study, we examine *how three aspects of adolescents' social relationships – peer popularity, indegree centrality, and betweenness centrality – are associated with accuracy in perceiving (a) one's own peer group and (b) others' peer groups (RQ3)*.

3. Methods

3.1. Background and data collection

Our data came from a larger study on adolescent behavior that included 1,512 adolescents from four schools in Lanzhou, China. Lanzhou is the capital city of Gansu province in northwest China and is a major industrial city with a population of approximately 2.1 million. The four schools were ordinary public high schools, where students came from nearby residential areas. Among the adolescents, 18.2% of mothers and 10.3% of fathers had an elementary school education, 44.8% of mothers and 43.4% of fathers had a junior high school education, 28.8% of mothers and 33.2% of fathers had a high school education, and 8.2% of mothers and 13.1% of fathers had some post high school education.[2] In terms of sibling status, 63% of the children had

[2] According to the 2008 Rural-Urban Migration in China and Indonesia Survey, average years of parents' schooling for 1986-1990 birth cohort was 10.4 years for urban children (Golley & Kong, 2013). According to Yeung (2013), 59% of respondents from urban origin reported father's

no siblings.[3] In general, the participants in the sample appear to be typical of adolescents living in provincial cities in China.

In two of the schools, data were collected from 10th grade students (a total of 6 classrooms in one school, and a total of 4 classrooms in another school). In one of the schools, data were collected from 7th grade students (a total of 8 classrooms). In the final school, data were collected from both 7th (a total of 8 classrooms) and 10th (a total of 6 classrooms) grade students. After listwise deletion of missing data on variables used in the models for 31 participants (2%), 1,481 students (724 boys and 757 girls) were kept in the analyses.[4] There were 756 students from 7th grade (mean age=13.50; 401 boys and 355 girls) and 725 students from 10th grade (mean age=16.76; 323 boys and 402 girls). Classroom size ranged from 30 to 59. For the analyses of peer group salience, out of 348 SCM-derived groups, 346 groups were included in the analysis after removing two groups with missing values in most of the relevant variables.

All materials and consent procedures were approved by the IRB at the first authors' institution. A faculty member and a graduate student at Beijing Normal University, in collaboration with graduate research assistants at the first authors' institution, translated measures and assessed the comprehensibility and cultural appropriateness of the items. School

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education level of elementary or junior high school, and 35% reported father's education of some senior high or above, which is comparable to our study sample.

[3] The estimated birth rate in 2007 is 1.5 children per couple (Baochang, Feng, Zhigang, & Erli, 2007). There are varying rules and levels of enforcement regarding one-child policy in different areas (Hesketh, Lu, & Xing, 2005) and siblings are probably more common in our study area than in major cities such as Shanghai and Beijing. Also, higher educated populations are less likely to have multiple children than less educated populations and those in farming occupations and from minority populations. The number of siblings in our study is fairly typical of areas outside of the major cities.

[4] We tested possible biases due to listwise deletion by running a set of analyses using multiple imputation in Stata 14 (StataCorp LP, College Station, TX) with *mi impute mvn* command. 10 imputations were performed and estimates from these 10 sets were combined. The estimates were substantively identical to model results obtained from listwise deletion. The final double-hurdle model is conducted with listwise deleted data.

principals from the four participating schools sent letters to parents introducing the study. These were accompanied by detailed information about the study, a consent form, and a questionnaire containing demographic items. Signed parental permission and adolescent consent were obtained. Overall participation rate was 88%. Students who participated in the study and teachers who completed their student ratings were provided with small school supplies as compensation.

3.2. Measures

Peer groups were identified using information from the administration of a standard SCM questionnaire (Cairns et al., 1990; Leung, 1998). Students were asked: "Which kids are in the group that you belong to?," and were not limited in terms of the number of names they could list. Second, they were asked: "Other students in your classroom belong to different groups. You might not be a member of these groups. Think about each of these groups and write down the names of the students who tend to hang around together." Students were asked to provide up to five different groups. The program SCM 4.0 (Leung, 1998) was used to derive the final groups.

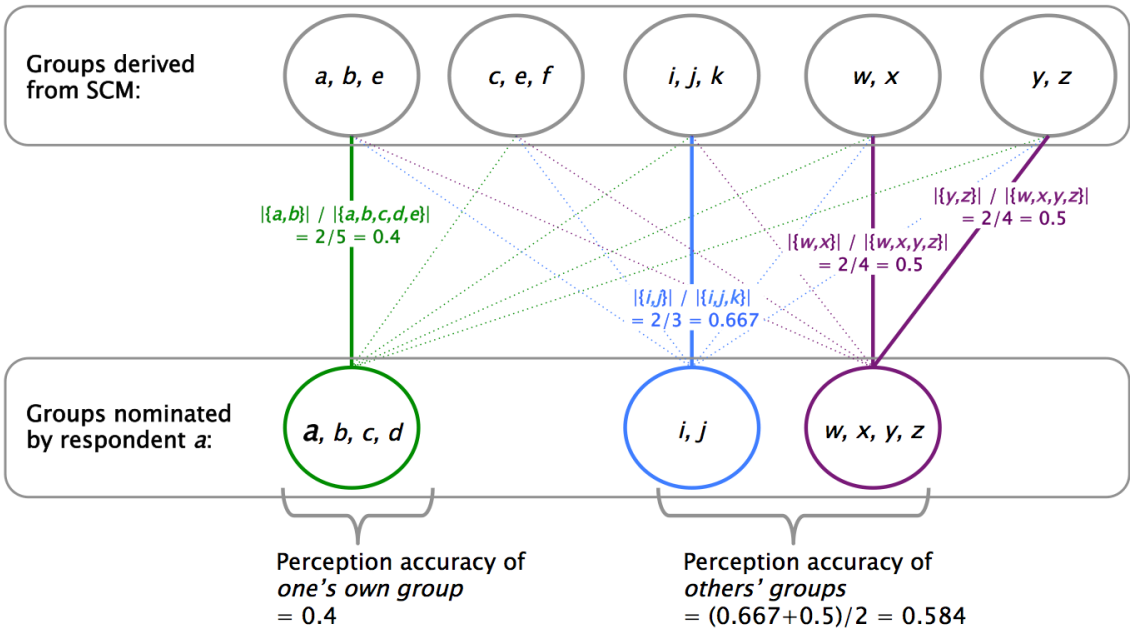
The key dependent variable was *perception accuracy*, which represents the similarity between groups named by a respondent and the final groups derived by the SCM procedure. Figure 2 illustrates the calculation steps. For each group that a respondent nominated, we measured how similar the group was to each of the groups identified by SCM, using the Jaccard coefficient. This measure has been used in other contexts to calculate similarities between sets of friends (e.g., Zheleva, Getoor, Golbeck, & Kuter, 2010). It is, simply, a ratio of the intersection (i.e., number of items in common) of two sets divided by the union (i.e., total number of unique items) of the two sets. Formally, given two sets A and B, it is defined as the following:

$$J(A,B) = \frac{|\,A \cap B\,|}{|\,A \cup B\,|}$$

In this study, if a respondent exactly identifies the members in an SCM group, the

respondent receives the highest possible score of 1. If the respondent identifies fewer, more, or different group members than the SCM group, then the score is reduced. For each group nominated by a respondent, we identified the maximum Jaccard score (see Figure 2: Jaccard score for groups matched with solid lines). Note that there can be two or more SCM groups that are equally similar to the group nominated by a respondent, as in the case of group $\{w,x,y,z\}$. To derive the final accuracy score, we then computed two average Jaccard scores – one for the groups the respondent claims to be a part of (i.e., perception accuracy of *one's own group*), and one for the groups the respondent does not claim to be in (i.e., perception accuracy of *others' groups*).

Figure 2. Illustration of calculating perception accuracy scores



Note. Solid lines indicate the maximum Jaccard score for each group nominated by respondent *a*, which contribute to respondent *a*'s final perception accuracy measures. Dotted lines indicate SCM groups with lower Jaccard scores, which do not contribute to final accuracy measures.

The following measures were used to capture individual attributes. First, *loneliness* was measured by a 10-item version of UCLA Loneliness Scale (Russell, 1996), which included items such as "How often do you feel you have nobody to talk to?," "How often do you feel as if

nobody really understands you?," and "How often do you feel it is difficult for you to make friends?". Responses were on a 4-point scale (1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *often*) and a mean of 10 items were used for the final measure (α = .84). Second, *self-esteem* was measured by Rosenberg's Self-Esteem Scale (Rosenberg, 1965). This is a 10-item scale measuring one's positive and negative feelings about the self, based on statements such as "I feel that I am a person of worth, at least on an equal plane with others," "I take a positive attitude toward myself," and "I certainly feel useless at times" on a scale of 1 = *strongly disagree*, 2 = *disagree*, 3 = *agree*, and 4 = *strongly agree*. Negative items were reverse coded, and a mean of 10 items was taken (α = .83).

Measures of academic performance and aggressive behavior were provided by teachers of each classroom. *Academic performance* was measured based on the mean of a student's scores on three subjects (Chinese, English, and Math) for final exams in the Spring and Fall semesters of the year. *Aggressive behavior* was a mean of five items rated by the teacher on a 5-point scale ranging from 1 = *extremely unlikely* to 5 = *extremely likely*: "gets into a lot of fights with others," "tries to keep certain people from being in his/her group during activities or play time," "says mean things or spread rumors about other kids when he/she is mad at them," "says mean things to others," and "is cruel to others" (α = .84).

Peer popularity was measured by asking students to choose up to five names from their class roster in response to the question, "Who are the most popular kids in my class?," and the frequency of being nominated as a popular kid was counted for each student. Centrality measures were based on a friendship network created from self-reports of close friends. A standard sociometric questionnaire item was used: "Provide information about five of your closest friends who are in the same grade in your school." Matrices for friendship ties were created for each grade (i.e., three for 10^{th} grade and two for 7^{th} grade). The *indegree centrality* measure, which

indicates the raw number of students nominating the person as a friend, was calculated using UCINET 6 (Borgatti et al., 2002). Indegree centrality relies on others' report and therefore is not affected by one's own report in the survey, being free from ego's bias (Casciaro, 1998). *Betweenness centrality* indicates the extent to which a node lies on the shortest paths between pairs of other nodes and was also calculated using UCINET 6.

3.3. Model specification

In order to address the corner solution properties of the perception accuracy variable that was bounded at 0 and 1, a double-hurdle model (Cragg, 1971; Wooldridge, 2010) was employed.[5] An alternative for the Tobit model, this model is used to separately estimate the likelihood of the dependent variable taking a non-zero value (a probit model) and the exact level of the dependent variable at non-zero observations (a truncated regression model). In our study, for the perception accuracy of one's own groups, scores of "0" appeared primarily when students did not identify anyone as part of their peer group (76 cases). For the perception accuracy of others' groups, respondents who either did not nominate any "other" peer groups or nominated peer groups of size 1 received a score of "0" (70 cases). With the double hurdle model, first, we predicted the probability of receiving a non-zero accuracy score, and second, the level of perception accuracy conditional on passing the first "hurdle" (i.e., having a non-zero score).[6] While we included the same sets of covariates in the two models, the double-hurdle estimation allows these covariates to have varying effects across the two models. Lastly, we calculated the unconditional average marginal effects, which are the combined effects of both stages of the

[5] We used the Cragg hurdle regression with the *churdle* command in Stata 14. The *margins* command was used to compute the marginal effects.

[6] Perception accuracy scores of "1" occurred when a student accurately identified all of the members of his or her own peer group (75 cases) or others' groups (1 case). Since an accuracy score of 1 is a continuum of the non-zero values and does not represent an additional "hurdle," we did not separately estimate the likelihood of the dependent variable taking a value of 1 or not.

double-hurdle model (Burke, 2009; García, 2013). Since our theoretical rationale applies to the whole range of accuracy scores reflected in both stages (i.e., 0 to 1) – being attentive to the peer group environment and willing to report about it, *and* actually being accurate in the perception –, we pay particular attention to the unconditional average marginal effects in discussing the results pertaining to the research questions.

Given the possibility that individuals' perception accuracy may be related to the number of groups they identified, we included a count variable capturing the number of others' groups answered as a control variable. Students' sex and grade were included as dummy variables. In all of the models, in order to account for classroom level effects such as teacher evaluations of aggressive behaviors, we included classroom-level fixed effects. Models without fixed effects are also reported as a robustness check. The grade variable was excluded in the models that contained classroom-level fixed effects. Further, the questionnaire asked about students' friendship ties within grade, which could lead to the dependency of network centrality measures among students in the same grade. To correct for these correlations within clusters (i.e., grades), we used cluster robust standard errors in all models (Cameron & Miller, 2015; Williams, 2000).

4. Results

4.1. Descriptive statistics

Means and standard deviations of 7th and 10th grade adolescents' psychological, behavioral, and relational traits as well as perception accuracy are presented in Table 1. In terms of SCM-derived groups, there were 173 peer groups each in 7th grade and 10th grade. Mean size of groups was 6.01 (SD = 2.59) for 7th grade and 5.54 (SD = 2.61) in 10th grade (see Table 2).

Table 1. Descriptive statistics (Individual level, *N* = 1,481)

Variables	7th (*N* = 756)				10th (*N* = 725)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Sex (Proportion of male)	47%				55%			
Number of others' groups nominated	3.92	1.39	0	5	4.18	1.17	0	5
Loneliness	1.87	0.65	0.3	3.9	2.17	0.60	1	4.9
Self-esteem	2.91	0.50	1	4	2.83	0.44	1.5	4
Academic performance (Z-score)	0.02	0.96	-2.48	1.93	0.03	0.93	-3.09	2.86
Aggressiveness	1.81	0.71	1	4.2	1.74	0.46	1	3.4
Peer popularity	2.13	3.94	0	30	1.88	3.44	0	35
Indegree centrality	4.11	2.42	0	17	4.04	2.05	0	11
Betweenness centrality	0.76	0.58	0	4.01	1.11	0.84	0	5.65
Perception accuracy (one's own group)	0.46	0.22	0	1	0.51	0.24	0	1
Perception accuracy (others' group)	0.40	0.18	0	1	0.50	0.19	0	0.95

Table 2. Descriptive statistics (Group level, *N* = 346)

Variables	7th (*N* = 173)				10th (*N* = 173)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Group size	6.01	2.60	2	14	5.54	2.61	2	17
Sex (Proportion of male)	0.55	0.49	0	1	0.43	0.46	0	1

4.2. Test of research questions

In RQs 1a, 2a, and 3a, we examined the predictors of accurate perception of a respondent's own peer groups. Results from two estimations, one with the classroom-level fixed effects (Model 1) and another without fixed effects (Model 2), are provided in Table 3. The probit coefficients in the first columns of each model show that females, those with higher peer popularity, and those with higher indegree centrality were more likely to have a non-zero accuracy score. The second columns present the model estimating the exact level of perception

accuracy, conditioned on having a score above zero. The effects of female and higher indegree centrality were consistent across the two models, both positively predicting the level of accuracy. Loneliness, peer popularity, and betweenness centrality had negative associations with the level of accuracy, only in Model 1 that included classroom-level fixed effects.

We focus our attention to the unconditional average marginal effects presented in the third columns of each model. In terms of demographic attributes, girls had more accurate perception than boys, and 10^{th} grade students had more accurate perception than 7^{th} grade students. As to psychological traits (RQ1a), self-esteem was negatively associated with perception accuracy. Behavioral attributes (RQ2a) did not show any significant associations with perception accuracy. In terms of social relationships (RQ3a), indegree centrality was positively associated with accuracy and betweenness centrality was negatively associated with accuracy. The results were consistent when class-level fixed effects were not included (Model 2).

Results regarding perceptions of peer groups that do not involve the individual (RQs 1b, 2b, and 3b) are shown in Table 4. The first column in Model 1 shows that females and those with higher aggressive traits were more likely to have an accuracy score above zero. In the model without classroom-level fixed effects (Model 2), higher grade and lower betweenness centrality additionally predicted the likelihood of a non-zero accuracy score. Conditional on having a non-zero accuracy score (see the second column, Model 1), being female, having low peer popularity, and having low betweenness centrality were associated with higher accuracy scores. In Model 2, higher grade and lower aggressive behavior were additionally associated with higher accuracy scores, while the effect of peer popularity was not significant.

Table 3. Results from double-hurdle model estimating adolescents' perception accuracy of one's own group

Model	1			2		
	Non-zero accuracy (probit)	Level of accuracy (truncated reg.)	UAME	Non-zero accuracy (probit)	Level of accuracy (truncated reg.)	UAME
Sex (Female)	0.158*** (0.033)	0.063*** (0.012)	0.065*** (0.012)	0.164*** (0.032)	0.064*** (0.012)	0.066*** (0.012)
Grade (10^{th})				-0.066 (0.065)	0.064** (0.025)	0.054* (0.018)
Loneliness	-0.046 (0.139)	-0.018* (0.009)	-0.018 (0.013)	-0.036 (0.147)	-0.018 (0.010)	-0.018 (0.014)
Self-esteem	-0.247 (0.141)	-0.014 (0.012)	-0.025*** (0.005)	-0.247 (0.141)	-0.015 (0.014)	-0.026*** (0.008)
Academic performance	0.056 (0.092)	0.006 (0.009)	0.008 (0.012)	0.055 (0.093)	0.002 (0.014)	0.004 (0.016)
Aggressiveness	-0.111 (0.063)	-0.010 (0.018)	-0.014 (0.019)	-0.116 (0.061)	-0.029 (0.018)	-0.032 (0.018)
Peer popularity	0.044*** (0.012)	-0.004* (0.002)	-0.002 (0.002)	0.043*** (0.012)	-0.004 (0.002)	-0.001 (0.002)
Indegree centrality	0.040* (0.020)	0.020*** (0.002)	0.020*** (0.002)	0.039* (0.020)	0.016*** (0.002)	0.016*** (0.001)
Betweenness centrality	-0.076 (0.041)	-0.055*** (0.012)	-0.053*** (0.011)	-0.062 (0.043)	-0.036 (0.020)	-0.035* (0.018)
Classroom fixed effects	Yes			No		
Log Pseudolikelihood	42.771			-20.831		
Wald Chi-square	2282.190			97.960		

Notes: n = 1,481. Model 1 includes classroom-level fixed effects, while Model 2 does not. Three sets of coefficients are reported for each model: probits on the probability of a non-zero perception accuracy score, conditional marginal effects on the level of accuracy from truncated regression, and unconditional average marginal effects (UAME). Cluster robust standard errors in parentheses. *p < .05, **p < .01, ***p < .001; two-tailed tests for variables.

Table 4. Results from double-hurdle model estimating adolescents' perception accuracy of others' groups

Model	1			2		
	Non-zero accuracy (probit)	Level of accuracy (truncated reg.)	UAME	Non-zero accuracy (probit)	Level of accuracy (truncated reg.)	UAME
Sex (Female)	0.337* (0.136)	0.061*** (0.010)	0.072*** (0.012)	0.324* (0.133)	0.057*** (0.008)	0.067*** (0.012)
Grade (10^{th})				0.355** (0.117)	0.089*** (0.016)	0.098*** (0.014)
Number of others' groups nominated		-0.010 (0.006)	-0.010 (0.006)		-0.006 (0.007)	-0.005 (0.007)
Loneliness	0.050 (0.084)	0.007 (0.004)	0.009 (0.005)	-0.002 (0.092)	0.006 (0.004)	0.006 (0.006)
Self-esteem	-0.057 (0.099)	-0.006 (0.011)	-0.008 (0.012)	-0.061 (0.100)	-0.010 (0.012)	-0.012 (0.013)
Academic performance	0.110 (0.095)	0.012 (0.007)	0.016* (0.007)	0.115 (0.090)	0.003 (0.010)	0.008 (0.007)
Aggressiveness	0.116** (0.044)	0.005 (0.007)	0.009 (0.006)	0.134*** (0.038)	-0.018* (0.008)	-0.012 (0.008)
Peer popularity	-0.006 (0.028)	-0.001** (0.000)	-0.002 (0.001)	-0.005 (0.028)	-0.001 (0.001)	-0.001 (0.001)
Indegree centrality	0.043 (0.027)	0.003 (0.002)	0.005 (0.003)	0.053 (0.028)	0.002 (0.002)	0.004 (0.002)
Betweenness centrality	-0.090 (0.080)	-0.007* (0.003)	-0.011* (0.005)	-0.169* (0.080)	-0.008*** (0.002)	-0.015*** (0.004)
Classroom fixed effects	Yes			No		
Log Pseudolikelihood	537.708			368.280		
Wald Chi-square	163.580			126.300		

Notes: n = 1,481. Model 1 includes classroom-level fixed effects, while Model 2 does not. Three sets of coefficients are reported for each model: probits on the probability of a non-zero perception accuracy score, conditional marginal effects on the level of accuracy from truncated regression, and unconditional average marginal effects (UAME). Cluster robust standard errors in parentheses. *p < .05, **p < .01, ***p < .001; two-tailed tests for variables.

The unconditional average marginal effects indicate the overall effects of the covariates regardless of the accuracy score being zero or not (see the third columns). Sex and grade were associated with the perception of other groups in a manner consistent with the results regarding the perception of one's own peer groups. The number of others' groups provided by the respondents was not significantly related to perception accuracy. Psychological traits (RQ1b) were not significant predictors, while academic performance was positively associated with accuracy (RQ2b). In terms of social relationships (RQ3b), only betweenness centrality was a significant negative predictor of the perception accuracy of others' groups. Estimates without class-level fixed effects were consistent except for the result that academic performance not significant (Table 4, Model 2).

5. Discussion

Integrating literature in the areas of adolescents' social identity, social networks, and social cognition, this study provides a unique contribution by focusing on adolescents' perception accuracy in the particular context of peer groups. The results from the double-hurdle model help understand the characteristics of adolescents with an accuracy score of zero. Overall, females were less likely to have a score of zero, reflecting the general tendency for females to have a stronger inclination towards friendships and social goals than males do (e.g., Rose & Rudolph, 2006), or at least a greater willingness to report on social environments. For perception of one's own groups, those who have higher peer popularity and higher indegree centrality were less likely to have a score of zero, indicating that these social ties and interaction may make them aware of and be motivated to report about their group membership. For perception accuracy of others' groups, those with aggressive traits were less likely to have a score of zero, implying that they might be more attentive to their relationship environment. We further interpret these results

below in relation to the findings regarding the level of perception accuracy.

A common pattern for both one's own group and others' groups was that girls and older adolescents had more accurate perceptions. These effects were consistent across both conditional and unconditional marginal effects. Adolescent girls have stronger motivations for maintaining friendships (Richard & Schneider, 2005) and report higher friendship quality at dyadic, triadic, and larger group levels (Laird, Pettit, Dodge, & Bates, 1999; Lansford & Parker, 1999; Rose & Asher, 1999). Porath (2001) suggested that girls have more reasoning capacity in interpersonal situations and hence report more of the network accurately than boys. In terms of age, Malloy, Albright, and Scarpati (2007) found that older children were more accurate in perceiving how they were judged by others than younger children did. Social cognition and interpersonal understanding is a reflection of children's ability to engage in abstract cognitive processes, which develop as they grow (Selman, 1980). Further, as adolescents spend more time with peers as they get older (Steinberg & Morris, 2001), they could have a stronger motivation to pay attention to peer groups. It is also possible that groups stabilize over time, making group identification easier.

It is notable that perception of peer groups in the two different contexts – one's own group and others' groups – is guided by different factors. Overall, psychological traits such as loneliness and self-esteem were only predictive of one's perception of their own peer group, consistent with the research suggesting a close link between adolescents' psychological processes and ingroup membership (Tanti et al., 2011). In contrast, perceptions of others' peer groups were predicted by behavioral traits such as academic performance and aggressive behavior, which relate to one's cognitive ability and motivation to understand the social environment. Interestingly, one's network relationships explained the perception of both one's own and others' peer groups, adding to the body of literature on the structural correlates of cognition (Krackhardt, 1992). We discuss each set of findings in greater detail below.

5.1. Psychological traits and accuracy

The findings pertaining to the relation between accuracy and self-esteem are consistent with Casciaro et al.'s (1999) argument that low self-esteem is associated with better local accuracy. Self-esteem is related to depression (e.g., Beck, 1967), and people with depressive symptoms tend to be more realistic in making self-relevant judgments such as in the case of evaluating the social structure that they are directly tied with. In addition, a reverse causal direction could exist where positive self-evaluations such as self-esteem are formed and maintained from an overly positive portrayal of one's ingroup compared to the outgroup (Tajfel, 1978; Tarrant, 2002). The positive portrayal could involve self-enhancement bias in identifying one's own group members (Leung, 1996). The current study shows that such a cognitive tendency may exist among adolescents when identifying peer groups.

The finding about loneliness is in contrast to the idea of depressive realism discussed above. Conditional on having a non-zero accuracy score, the result shows a negative association between loneliness and accurate perception of one's own group (Table 3, Model 1). Loneliness is associated with low peer acceptance (Mayeux & Cillessen, 2008) and may hinder children's understanding of the social environment. The result can also be supported by the findings that loneliness was associated with inaccurate self-perceptions (Cillessen & Bellmore, 1999) and lower self-determined friendship motivation (Richard & Schneider, 2005).

5.2. Behavioral traits and accuracy

The result regarding academic performance is consistent with previous findings. Conzelmann et al. (2013) showed that academic intelligence correlates with social memory and performance on some social perception tasks. There are several mechanisms that could cause this result: first, there may be a similar cognitive operation underlying academic intelligence and social memory (Conzelmann et al., 2013), and since accurate perception relies on the ability to

recall, social memory such as memory for names and faces (Sternberg, Conway, Ketron, & Bernstein, 1981) could play an important role. Second, social access and knowledge may be partially a function of academic performance. In Chinese schools in particular, academic excellence is strongly expected by teachers and parents. Adolescents who do poorly in school may experience difficulties in forming relationships with peers, which may lead to restricted opportunities to develop appropriate social knowledge (Chen et al., 1997). Finally, there could be an alternative causal mechanism, in which those who perceive groups more accurately may be able to associate with particular peer groups that influence them to adopt norms and values that could facilitate their academic performance (Wentzel & Caldwell, 1997).

The result regarding aggressive behavior is noteworthy. While there is evidence that aggressive adolescents may exaggerate their own sociometric status, we did not find a link between aggressiveness and perception of one's own group. As to others' groups, aggressive children were less likely to have an accuracy score of zero (Table 4, Models 1 and 2), suggesting that the conceptualization of a smart bully (Sutton et al., 1999) may apply to Chinese adolescents. In other words, paying attention to and understanding the social environment may be part of what makes them effective in engaging in bullying behavior. This is particularly likely since we measured both relational and physical aggressiveness. However, the estimated coefficient from truncated regression shows that conditional on having a non-zero score, aggressiveness was negatively associated with accuracy.[7] This implies that aggressive children are more likely to report about the membership of outgroups, but if they report, they will tend to be less accurate.

5.3. Relational traits and accuracy

[7] This finding should be taken with a grain of salt, as the aggressiveness measure is teacher-reported, and aggressiveness is not significantly associated with the level of accuracy when classroom-level effects are included.

Previous studies show that an individuals' position, especially being central in a network, is associated with their ability to accurately perceive the social structure. Partly in contrast with literature, our study shows that students with high indegree centrality have more accurate perceptions of their own peer group, but not of others' peer groups. This finding was consistent with the estimations of both the likelihood of having a non-zero accuracy score and the exact level of accuracy. The results could be due to several unique social ecologies that exist around adolescents' peer groups. Eder (1985) raised the possibility that those who are more popular can be more exclusive in who they pick for friends, suggesting that they may have a better idea of who is in their group than individuals who do not have as much of an ability to exclude people from their group. Additionally, deviant ingroup members were more likely to be thrown out and not be liked than deviant outgroup members (Abrams, Rutland, & Cameron, 2003). Thus, it could be expected that once a person is in a popular group, the relations within the group become important to know in order to maintain their standing in the group. Lastly, individuals from a high status group are found to identify more with and favor the their own group, while individuals in a low status group are likely to rate ingroup and outgroup members more equally and have desire to switch groups (Bigler, Brown, & Markell, 2001; Nesdale & Flesser, 2001).

Peer popularity partly contributed to perception, but only in the sense of having an accuracy score above zero. Conditional on having a non-zero score, the effect of peer popularity was negative. Overall, it shows that intimate, dyadic friendships measured by indegree centrality contribute to the accurate perception of one's own group, while being popular additionally contributes to clearing the "hurdle" (i.e., receiving a score above zero). This finding suggests that there may be important differences between adolescents who are seen as popular and those who are frequently nominated as friends.

The results regarding betweenness centrality are notable. Once degree centrality was

controlled for, individuals with high betweenness centrality had lower perception accuracy in terms of both one's own groups and others' groups. In viewing one's own groups, it makes sense that adolescents whose friendship relations span diverse social groups are less embedded in their own peer group and may have conflicting ideas about their group belonging and membership, thus being less accurate.

In terms of viewing others' groups, the negative association is in contrast to existing literature on the advantages of brokerage (e.g., Burt, 2004). It could be that in accordance with Bondonio (1998) and Casciaro (1998), in the particular context of network perception, the amount of information captured by degree centrality is more important than the power of information control captured by betweenness centrality. In addition, in contrast to organizational settings, children might not be strategically oriented to take advantage from network knowledge and thus not pay attention to the diverse information that is available. Further, what might explain the negative association between perception accuracy and betweenness centrality is the structural location of brokers. Those who are high in betweenness tend to be located at the periphery of social clusters (e.g., Granovetter, 1973; Perry-Smith & Shalley, 2003). Therefore, once the amount of information exchange is controlled for, those children might be less aware of the details of information regarding the members and structures of peer groups. Another possible mechanism moves in the other direction. Perhaps in this context, adolescents prefer to be part of just one peer group, and those who have high betweenness may be on the periphery of multiple groups because they do not have the social abilities to obtain the preferred network position. In this case, rather than being a position of power, brokerage appears to be the result of an inability to manage one's network.

5.4. Limitations and future studies

This study does not make claims about causality. While we examined the predictors of

perception accuracy, perceptions could at the same time impact various psychological, behavioral and relational outcomes. Alternatively, the associations we found between the predictors and perception accuracy could be due to hidden variables that cause both perception and some of the psychological, behavioral and relational outcomes. A longitudinal analysis will help to disentangle these causal dynamics. While there is considerable evidence for the impact of perception accuracy on better performance outcomes in organizations (Brands, 2013; Krackhardt, 1990; Shah, 1998), the role of adolescents' social perceptions on their psychological and social outcomes remains to be studied (Badaly, Schwartz, & Gorman, 2012; Cillessen & Bellmore, 1999). Longitudinal studies could also capture the changes in perceptions over time. Social groups are dynamic, especially after classrooms are shuffled (Cairns et al., 1995), and it would be worthwhile to examine how children perceive these changes and subsequently make adjustments to their peer groups.

There are additional methodological limitations. This study considered SCM-derived groups as the "real group" against which to compare an individual's perception. This approach is similar to the utilization of consensus structure in CSS studies (Krackhardt, 1987). While sociometric methods for identifying dyadic friendships are relatively straightforward, identifying social groups is a complex process and varied approaches have been used (Cairns et al., 1998). Had we chosen to use one of the other methods of detecting peer groups (Gest et al., 2007), our findings could differ.

We also could have chosen other methods for measuring perception accuracy. The Jaccard score used in this study has the benefit of taking group size into account in an intuitive way. For example, a respondent who nominated 3 members of a 4-student group receives a higher Jaccard score than a respondent who nominated 2 members of 3-student group, reflecting the higher complexity of the perception task. Measures such as the simple number of incorrect

nominations do not correct for the size of the groups. However, our perception accuracy measure does not account for groups that are not identified by a respondent. For example, a respondent who identified one group perfectly gets a perfect score, but someone who identified one group perfectly and 2 other groups reasonably well gets a lower score. In this sense, the measure punishes respondents who have a wider perception range but are less accurate, or respondents who might be simply "ambitious" in their answers.

Further examination of cultural differences could enrich our understanding of adolescents' perceptions and cognitions. There has been an in-depth discussion of peer relationships from cultural perspectives (e.g., Chen, French, & Schneider, 2006) but not much has been found about network perceptions across cultural contexts. The context in which peer groups are formed depends on the curriculum, structure of the education system (Cairns et al., 1998), as well as extracurricular activities. Peer groups are also formed to serve different functions. For example, the Chinese culture emphasizes the socialization function of peer groups in helping children learn social norms and develop appropriate behaviors (Chen, 2000; Chen, Chang, He, & Liu, 2005). Children's perceptions of these peer groups could also depend on broader cultural contexts, such as the extent to which schools and larger society place value on collectivistic versus individualistic behaviors.

Lastly, adolescents' perception patterns may be influenced by unique cognitive patterns as compared to adults' perceptions. Recent research has examined how networks are represented in the mind (Brashears, 2013; Brashears & Quintane, 2015), and applying these approaches to adolescents could enrich the study of adolescents' perceptions of social structures.

6. Conclusion

Overall, this study has implications for theorizing adolescents' cognitions of peer groups.

Our results suggest that adolescents' perceptions of peer groups may be influenced by their own attributes as well as the relationship ecologies surrounding them. Since a large majority of studies on adolescents rely on self-reported network data, recognizing and understanding the systematic biases that exist in adolescents' perception suggests caution in how we use the findings and presents opportunities to control for biases. Practically, given the social influence peer groups potentially hold, a better understanding of which students might misunderstand their social environment can help school practitioners to be effective in their pursuits to improve peer interactions. Future studies are encouraged to extend our understanding of the dynamics of psychological and behavioral traits, social relationships, and social cognition surrounding adolescents' peer groups.

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