



Seeing and being seen: Predictors of accurate perceptions about classmates' relationships



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ABSTRACT

This study examines predictors of observer accuracy (i.e. seeing) and target accuracy (i.e. being seen) in perceptions of classmates' relationships in a predominantly African American sample of 420 second through fourth graders (ages 7–11). Girls, children in higher grades, and children in smaller classrooms were more accurate observers. Targets (i.e. pairs of children) were more accurately observed when they occurred in smaller classrooms of higher grades and involved same-sex, high-popularity, and similar-popularity children. Moreover, relationships between pairs of girls were more accurately observed than relationships between pairs of boys. As a set, these findings suggest the importance of both observer and target characteristics for children's accurate perceptions of classroom relationships. Moreover, the substantial variation in observer accuracy and target accuracy has methodological implications for both peer-reported assessments of classroom relationships and the use of stochastic actor-based models to understand peer selection and socialization processes.

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The classroom is a key social environment in childhood. In the United States, children ages 6–12 are estimated to spend over thirty hours per week in school (Hofferth, 2009; Hofferth and Sandberg, 2001) and interact with the same classroom peers daily (Gifford-Smith and Brownell, 2003). The structure of these classroom peer networks has been linked to a variety of positive and negative behaviors including aggression (e.g., Ahn et al., 2010; Farmer and Xie, 2007; Molano et al., 2013; Neal and Cappella, 2012), and academic engagement and motivation (e.g. Cappella et al., 2013; Kindermann, 1993). However, although much developmental research has focused on attempting to understand the actual structure of classroom peer networks, the *accuracy* of children's perceptions of classroom peer relationships within these networks may also be important to explore. That is, to what extent do children's perceptions of peer relationships match the relationships that actually exist in the classroom?

Based on theory and past research on the accuracy of interpersonal perception, accurate perceptions of classmates' relationships are expected to vary by both the children forming perceptions (observers) and the pairs of classmates about whom perceptions

are formed (targets; see Kenny and Albright, 1987 for review). Certain observers may be better at seeing relationships between their classmates, leading to differences in accuracy between observers. Likewise, certain targets may be seen more easily by observers, leading to differences in accuracy between targets. Thus, in colloquial terms, accuracy about classmates' relationships potentially requires both seeing and being seen. Studying the accuracy of children's perceptions of classroom peer relationships is *theoretically* important because behavior may be more strongly associated with individuals' perceptions of peer relationships than the actual network structure of these relationships (Krackhardt, 1987). Moreover, children's behavior may be more likely to yield intended outcomes when their perceptions of peer relationships are more accurate (Krackhardt, 1990). Examining the accuracy of children's perceptions of classroom peer relationships also fills *empirical* gaps in the current developmental literature on interpersonal perception, which has focused more extensively on children's accurate perceptions about their own personal social status (e.g., Cillessen and Bellmore, 1999; Malloy et al., 2007) or friendships (e.g., Badaly et al., 2012). Finally, studying the accuracy of children's perceptions of peer relationships has *methodological* implications for the peer-reported measurement of classroom networks (e.g., Cairns and Cairns, 1994; Neal, 2008) and the extent to which a critical assumption of stochastic actor-based models – that all actors have some level of accurate knowledge of the network – is violated in developmental research (Snijders et al., 2010).

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The goal of the current study is to understand variation in the accuracy of children's perceptions of classroom peer relationships. We begin by reviewing social network studies that focus on the magnitude of and outcomes associated with accurate perceptions of relationships among adults and children, and discussing methodological implications. Next, we review past literature on four predictors of observer accuracy (i.e., seeing) and target accuracy (i.e., being seen) in childhood: grade, class size, gender, and perceived popularity. We extend the empirical research in this area by examining how each of these predictors are associated with observer and target accuracy among 420 urban African American second through fourth grade students in 33 classrooms. Results suggest the importance of both observer and target characteristics for children's accurate perceptions of classroom relationships. Moreover, the substantial variation in observer accuracy and target accuracy has methodological implications for both peer-reported assessments of classroom relationships and the use of stochastic actor-based models to understand peer selection and socialization processes.

1. Background

1.1. Accurate perceptions of relationships

Network studies of accurate perceptions of relationships have a long history, dating to an influential set of studies conducted by Bernard, Killworth, and Sailor (BKS) (see [Bernard et al., 1984](#); for review). The BKS studies of accuracy focused on adults' reports of their own communication with others, finding that "what people say about their communications bears no useful resemblance to their behavior" ([Bernard et al., 1984](#); p. 499). Since these studies were published, others have argued that while individuals struggle to report specific interactions, they may be more accurate in their recall of long-term stable communication patterns (e.g., [Freeman et al., 1987](#)).

These initial studies of accuracy in adults' reports of their own interactions prompted network researchers to begin exploring accuracy in adults' reports of others' interactions and relationships. Specifically, [Krackhardt \(1987\)](#) developed cognitive social structures (CSS) as a method to assess individuals' perceptions of the entire network structure in a setting, arguing that perceptions rather than the actual network structure may be a more critical determinant of behavior. For example, [Krackhardt and Kilduff \(1999\)](#) note that "perceptions of the social network . . . help determine whether the individual takes action and how effective that action is likely to be. The structure of relations can both enable and constrain action, and this social structure rests on the underlying pattern of perceptions in people's minds" (p. 770). That is, consistent with a phenomenological perspective ([Bronfenbrenner, 1979](#)), individuals act based on their own, often imperfect, perceptions of social relationships in a setting. Additionally, and perhaps more importantly, the accuracy of perceptions of social relationships is key for individuals' ability to behave in a way that leads to an intended effect or outcome ([Krackhardt, 1990](#)). For example, Maya may want to climb the social ladder in her classroom and may perceive that Brittney has lots of friends. Based on this perception, she may try to form a friendship with Brittney. This behavior, based on Maya's perception, will be more effective in achieving her goal (i.e., climbing the social ladder) if Brittney actually does have lots of friends.

CSS provides flexible methods of assessing individual accuracy against confirmed self-reported relationships (i.e., using locally aggregated structures) as well as reports by a consensus of individuals in a setting (i.e., using consensus aggregation) (e.g., [Bondonio, 1998](#); [Brands, 2013](#); [Krackhardt, 1987](#)). CSS studies of adults have primarily focused on both the predictors and outcomes of observer

accuracy, rather than target accuracy, in perceptions of relationships. For example, studies have explored how aspects such as network centrality, perceptions of power, demographics, and personality traits are associated with observer accuracy of the social network structure in workplaces or network experiments (e.g., [Bondonio, 1998](#); [Casciaro, 1998](#); [Casciaro et al., 1999](#); [Simpson et al., 2011](#)). Moreover, consistent with the idea that accurate perception may yield more effective outcomes, additional studies of adults have demonstrated that observer accuracy of social relationships are linked to benefits such as leadership, power, and positive work outcomes (e.g., [Balkundi and Kilduff, 2006](#); [Krackhardt, 1990](#)).

Compared to adult studies, the literature on children's perceptions of classroom peer relationships is more limited and has focused solely on predictors rather than outcomes of observer accuracy (e.g., [Cappella et al., 2012](#); [Neal et al., 2014](#)). This past research on children's perceptions of classmates' relationships has focused on how situational characteristics (e.g., class size, teacher emotional support) and observer attributes (e.g., grade, gender) affect observer accuracy ([Cappella et al., 2012](#)). Like the adult studies, studies of children's perceptions of classroom peer relationships have not yet considered factors that affect target accuracy. Additionally, prior work ([Cappella et al., 2012](#); [Neal et al., 2014](#)) has not yet considered the role of social status as a predictor of the accurate perception of classmates' peer relationships. Being perceived as popular by classroom peers could be associated with increased observer accuracy – but also may affect target accuracy. That is, it may be easier to see relationships between classmates who are perceived as popular in the classroom.

In addition to theoretical and empirical motivations, studying the accuracy of children's perceptions of classmates' relationships has important methodological implications for network measurement and modeling. First, it may help refine peer-reported techniques for measuring children's classroom relationships, including social cognitive mapping ([Cairns and Cairns, 1994](#)) and cognitive social structures ([Neal, 2008](#)). These techniques typically triangulate responses across a set of peer observers to measure the structure of relationships in a classroom or grade. However, each observer and each reported relationship is treated as equally accurate. Studying variation in children's accurate perceptions of peer relationships can help determine whether refinements to these approaches could lead to more precise measurement.

Second, it examines a critical assumption of stochastic actor-based models ([Snijders et al., 2010](#)), which have become increasingly popular in social research for disentangling the effects of selection and influence. In the specific context of developmental psychology, these models have been used to explore network formation among preschool children (e.g., [Schaefer et al., 2010](#); [Martin et al., 2013](#)), ethnic segregation in middle childhood and adolescence ([Leszczensky and Pink, 2015](#)), and were recently used in 15 papers featured in a special issue on network dynamics in the *Journal of Research on Adolescence* (see [Veenstra et al., 2013](#)). However, depending on the types of effects to be estimated, these models require assuming that network members have some level of accurate information about the network, ranging from "full information about network structure and composition" ([Veenstra et al., 2013](#), p. 402) to "more limited information" ([Snijders et al., 2010](#), p. 46). Studying variation in and predictors of children's accurate perceptions of peer relationships can help illuminate when these assumptions are satisfied, and the severity of their potential violation.

1.2. Predictors of accurate perceptions of relationships in childhood

Many different factors may be associated with children's accuracy in perceiving relationships. Here, we focus on four factors for

which there is sufficient past research to develop specific, testable hypotheses.

1.2.1. Grade

Developmental changes may increase an observer's accuracy in perceptions of classmates' relationships, that is, a child's ability to see relationships. As children develop, they experience gains in social cognition that increase their ability to engage in accurate interpersonal perceptions (Cillessen and Bellmore, 2011; Dodge and Price, 1994). In school-based studies, grade level is often used as a proxy to assess developmental effects. These studies indicate that children in higher grades are more accurate in judging how their own social status, behaviors, and abilities are perceived by peers (Ausubel et al., 1952; Malloy et al., 1996, 2007). Children in higher grades also exhibit more agreement with the consensus of classmates on reports of the presence of peer relationships in classrooms (Cappella et al., 2012). Thus, we hypothesize that children in higher grades will have more accurate perceptions of their classmates' relationships (**H1A**).

Developmental changes may also increase accuracy about a target (i.e., a pair of children who are seen by others). As children grow older, they tend to have more stable relationships (e.g., Cairns et al., 1995; Gifford-Smith and Brownell, 2003). This increase in stability should make it easier to accurately observe classmates' relationships in higher grades, reflected in increased accuracy about targets. Thus, we hypothesize that relationships between pairs of children in higher grades will be more accurately perceived (**H1B**).

1.2.2. Class size

Class size may also have implications for accurate perceptions of classmates' relationships. Because the number of possible dyads increases geometrically with class size (e.g. $\text{dyads} = (\text{size}^2 - \text{size})/2$), even small increases in class size dramatically increase the number of dyads that children must try to observe. In such socially crowded settings, observers may have difficulty seeing relationships and targets may not be seen, thus diminishing both observer and target accuracy. In line with this, previous research demonstrated that children in larger classrooms exhibited less agreement with the consensus of peers on reports of the presence of relationships in the classroom (Cappella et al., 2012). Thus, we hypothesize that children in smaller classrooms will have more accurate perceptions of classmates' relationships (**H2A**) and that relationships between pairs of children in smaller classrooms will be more accurately perceived (**H2B**).

1.2.3. Gender

In middle childhood, girls and boys differ in their social cognitions in ways that may affect their accuracy as observers of their classmates' relationships. Specifically, girls tend to exhibit relationally focused social cognitions such as empathy and goals of maintaining social connections. In contrast, boys tend to exhibit agentic social cognitions such as goals to maintain their own social status (see Rose and Rudolph, 2006 for review). However, despite these distinctions in social cognition, research on gender differences in the accuracy of interpersonal perceptions has been mixed (Cillessen and Bellmore, 2011). Some studies have demonstrated that girls exhibit more accurate perceptions of their own or others' competencies and social status than boys (e.g., Cillessen and Bellmore, 1999; LaFontana and Cillessen, 1999; Smith et al., 2013) while others have found few or limited gender differences (e.g., Malloy et al., 1996, 2007). Additionally, while Cappella et al. (2012) found that girls exhibited higher levels of agreement with the consensus of peers on the presence of relationships in a bivariate analysis, they found no gender differences in a hierarchical linear model that controlled for other individual and classroom effects. These mixed findings in the literature likely reflect

differences in sample and the measurement of interpersonal perception, and more research is needed to determine if gender affects observer accuracy.

Gender may also play a role in target accuracy. In particular, the gender composition of the target dyad may make the relationship between them easier or harder to observe. Middle childhood is characterized by a strong tendency for children to affiliate in sex-segregated groups, a phenomenon highlighted in the two cultures theory of gender development (Maccoby, 1990, 1998). Moreover, as early as preschool, children develop social cognitions that their peers prefer same-sex play partners (Martin et al., 1999). Indeed, by middle childhood, children tend to overestimate the importance of sex similarity when inferring the existence of classmates' relationships (Neal et al., 2014). Because children tend to exhibit strong expectations of and biases toward perceiving same-sex relationships in middle childhood, relationships may be more easily observed between same sex pairs of classmates. Thus, we hypothesize that relationships between pairs of same-sex children will be more accurately perceived (**H3**).

1.2.4. Perceived popularity

Social status in classrooms can take different forms and may depend on how well liked a child is by peers (i.e., sociometric status) or how popular a child is perceived to be by peers (i.e., perceived popularity) (e.g., Coie et al., 1982; Parkhurst and Hopmeyer, 1998). In this paper, we focus specifically on associations between children's perceived popularity and accurate perceptions of classroom relationships. Unlike sociometric status, perceived popularity is linked to increased social control and skills that allow children to effectively manipulate social relationships (Badaly et al., 2012; Cillessen and Bellmore, 2011). Thus, children who more accurately perceive classmates' relationships (a skill that increases the ability to manipulate social relationships) may be better able to advance their popularity. Children who are perceived as popular are also typically well positioned in the classroom social hierarchy (Cillessen and Bellmore, 2011; Lease et al., 2002b). This positioning may provide popular children with an advantage in accurately observe classmates' relationships. Based on this literature, we hypothesize that children with higher levels of perceived popularity will have more accurate perceptions of classmates' relationships (**H4A**).

Perceived popularity may also be associated with accuracy about a target. Because popular children are at the top of the social hierarchy, their relationships may be more salient and easy to observe. For example, children and early adolescents often describe popular peers as displaying many socially visible characteristics like athleticism, attractiveness, and being cool (LaFontana and Cillessen, 2002; Lease et al., 2002a; Rodkin et al., 2006; Xie et al., 2006). Because popular peers may be more socially visible, making them targets that can easily be seen, we hypothesize that relationships between pairs of children with higher average perceived popularity scores will be more accurately perceived (**H4B**). Similarly, because children are more likely to affiliate with similar status peers (Farmer et al., 2009), relationships between peers of similar levels of perceived popularity may conform to observer expectations. Thus, we hypothesize that relationships between peers of similar levels of perceived popularity will be more accurately perceived (**H4C**).

2. Method

2.1. Setting and sample

This study includes data collected from 420 children in 33 second through fourth grade classrooms (ages 7–11) in

five urban public elementary schools located in a large Midwestern city in the United States. All participating children provided assent, and we obtained active consent from their parents. Most participants were African American (97.3%) and were eligible for free or reduced price lunch (97.7%), and the sample was evenly split by gender (53.8% female) and grade (31% second grade, 36% third grade, and 33% fourth grade).

This sample represents an overall response rate of 62.7%, which ranged within classroom from 45% to 92%. Although each participant provided their perceptions of relationships among all of their classmates, because our measurements of accuracy are rooted in a self-reported ground truth (see Measures below), we only use their perceptions of relationships among other participating classmates. Accordingly, the participants provided information on 39% of all possible within-classroom dyads, which ranged from 19.4% to 84.3% by classroom. Thus, an observer's accuracy is measured below based on their perceptions of between 19.4% and 84.3% of the dyads in their classroom, while a target's accuracy is measured below based on perceptions of the target by between 45% and 92% of the children in their classroom.

These response rates are consistent with other studies collecting data from children in U.S. schools (Cairns and Cairns, 1994; Neal, 2008). Although they are lower than may be desirable for the construction of classroom social networks, they are not problematic here for three reasons. First, we do not attempt to construct complete classroom social networks or compute network indices (e.g. centrality). Second, participants did not differ from non-participants in terms of grade level. Girls were slightly more likely to participate than boys ($\chi^2 = 9.52, p < .01$), and participants exhibited very slightly higher levels of perceived popularity ($M = 0.03$) than non-participants ($M = -0.07; t = -4.0, p < .01$). Third, if we restrict our sample to only classrooms with response rates above 60%, yielding an overall response rate of 73% in which participants provide information on 54% of all possible within-classroom dyads, the direction and magnitude of the estimates presented below remain unchanged. This suggests that our findings are not biased by the inclusion of data from classrooms with lower response rates.

2.2. Procedure

Participating students completed two consecutive 30-minute surveys in their classrooms. The first survey used cognitive social structures (CSS) to collect data used to assess both children's perceptions of classmates' relationships and reciprocated self-reported relationships, which are compared to construct the measure of accuracy described below (Neal, 2008). For every child in their classroom (including themselves), participants were provided a complete class roster and asked to "please circle the names of all of the kids in your classroom that <child's name> hangs out with often". "Hanging out" relationships are particularly suitable for this study because they are behavioral by definition, and therefore more tangible to perceive than friendships, which are often based on less visible features like affection (Rodkin and Ahn, 2009). The second survey used a peer nomination procedure and included sociometric measures designed to assess children's assessment of their classmates' behavior as well as their perceived popularity (Metropolitan Area Study Group, 2002). Children were allowed to make unlimited nominations of their classmates. In each classroom, one of the lead researchers administered the surveys with the assistance of research assistants.

2.3. Measures

2.3.1. Predictors

We measured grade level and class size using classroom rosters collected from each of the five schools.¹ Class sizes reflected the total number of students in a classroom, including both participants and non-participants, and ranged from 10 to 34 ($M = 22.3, SD = 6.5$). Teachers reported the gender of each participating student. In this study, the binary variable, FEMALE, is coded as 1 for girls. Teacher-reported gender was also used to create variables reflecting the composition of targets. The binary variable, BOY-BOY, was coded as 1 when both peers in the pair were male, and the binary variable, GIRL-GIRL, was coded as 1 when both peers in the pair were female; in the models presented below, mixed-gender dyads (i.e. BOY-GIRL) are the omitted category.

We assessed peer-nominated perceived popularity by subtracting the proportion of classroom respondents who nominated a given child as "least popular" from the proportion of classroom respondents who nominated the child as "most popular" (Lease et al., 2002a). Perceived popularity scores have a theoretical range from -1 (i.e., a child was nominated by all classroom respondents as least popular) to 1 (i.e., a child was nominated by all classroom respondents as most popular). To capture the popularity composition of targets, the variable MEAN PP measures the mean perceived popularity of the two dyad members and the variable DIFF PP measures the absolute difference in the two dyad members' perceived popularity.²

2.3.2. Accuracy of perceptions of classmates' relationships

Assessing accuracy requires establishing a ground truth or criterion against which perceptions are tested. Relationships are often defined in the literature as "reciprocated positive feelings" (Bukowski and Hoza, 1989, p. 30). Moreover, the only individuals who have direct knowledge of the existence of a relationship are the individuals actually involved in the relationship (Neal et al., 2014). In this study, following Neal et al. (2014), reciprocated, self-reported "hanging out" relationships were used as the criterion. These data are the best available indicators of the true relationships in a classroom because they are obtained directly from the individuals involved in the relationships and because they have been confirmed by both members of the relationship.³

Given a two-by-two contingency table:

	Observer reports that <i>i</i> and <i>j</i> hang out	Observer reports that <i>i</i> and <i>j</i> do not hang out
<i>i</i> and <i>j</i> both report hanging out	A	B
<i>i</i> and <i>j</i> do not both report hanging out	C	D

¹ We use grade level rather than age for several reasons. First, these two variables are highly correlated ($r = 0.81$). Second, because age was collected using self-report, it is missing for 32 respondents and is subject to error, while because grade was collected from official school rosters, it is available and accurate for all respondents. Finally, in our data we only have access to age in years, but do not have actual birthdates. We expect greater differences in development between two children of the same age in different grades (e.g. an 8 year old in 2nd grade vs. an 8 year old in 3rd grade) than between two children of different ages in the same grade (e.g. a 7 year old in 2nd grade who is just weeks away from a birthday vs. an 8 year old in 2nd grade who just had a birthday).

² The data also included peer-nominated social preference (i.e., liked most – liked least nominations), which is not used in these analyses because it was highly correlated with perceived popularity ($r = 0.701$).

³ Non-reciprocated self-reported "hanging out" relationships might be viewed as a gray area. In this study, following Neal et al. (2014), we define these as *not* true relationships because the positive feelings are not reciprocated (Bukowski and Hoza, 1989). However, additional analyses indicated that the results presented below are unchanged if these gray area cases are excluded from analysis.

Table 1
Descriptive statistics and correlations of observer variables.

Variable	Mean	SD	Pearson correlation coefficient			
			Kappa	Grade	Class size	Female
Kappa	0.371	0.207	–			
Grade	3.021	0.798	0.149*	–		
Class size	22.302	6.512	–0.230**	0.226**	–	
Female	0.538	0.500	0.116†	0.073	0.026	–
Perceived popularity	0.033	0.325	0.022	0.008	–0.121†	0.193**

N=420 observers.

† p < .05.

** p < .01.

where each cell contains the proportion of times each outcome occurred for a given observer, the observer’s accuracy in perceiving whether a pair of children hangs out was measured using Cohen’s κ :

$$\kappa = \frac{Pr(a) - Pr(e)}{1 - Pr(e)}, \text{ where}$$

$$Pr(a) = \mathbf{A} + \mathbf{D}$$

$$Pr(e) = ((\mathbf{A} + \mathbf{C}) * (\mathbf{A} + \mathbf{B})) + ((\mathbf{B} + \mathbf{D}) * (\mathbf{C} + \mathbf{D}))$$

The first term, Pr(a), captures the raw level of agreement, while the second term, Pr(e), captures the expected or chance level of agreement that would be achieved by guessing. Thus, Cohen’s κ assesses the extent to which the observer’s perceptions of classmates’ relationships match the criterion, beyond what would be expected by chance, and has been used in past studies of observer accuracy (Badaly et al., 2012; Bellmore and Cillessen, 2003; Cillessen and Bellmore, 1999).

In measuring a target’s accuracy (i.e. observers’ accuracy in perceiving a given target), the unit of analysis is a single pair of children, *i* and *j*. Cohen’s κ cannot be computed in this case because the criterion, whether or not *i* and *j* in fact hang out, is constant over all observers and thus either the term A+B or the term C+D is constrained to zero. We instead measure target accuracy using a modified measure that is conceptually similar. As with Cohen’s κ , the raw level of accuracy, Pr(a), is measured as the proportion of times an observer’s report about a target matched the target’s own report whether they hang out. The expected level of accuracy, Pr(e), was measured as the proportion of times an observer’s report about a target would have matched the target’s own report, if each observer guessed and reported for this target what they perceive for most other targets. This approach relies on a relatively simple logic for observer guessing behavior. If a child thinks that a majority of pairs of children in their classroom hang out, then when faced with uncertainty about whether a particular pair of children hang out together, he or she is likely to guess that this pair also hang out together. Likewise, if a child thinks that a majority of pairs of children in their classroom do not hang out, then when faced with uncertainty about a particular pair, he or she is likely to guess that this pair also do not hang out. Thus, like Cohen’s κ , this modified measure also captures the extent to which reports match the criterion, beyond what would be expected by chance. Both measures of accuracy have a theoretical range from –1 to 1, where scores of 0 indicate chance levels of accuracy.

3. Results

Table 1 report descriptive statistics and bivariate correlations for variables used to characterize observers. Fig. 1 illustrates the distributions of the two outcomes of interest: observer accuracy and target accuracy. There was substantial variation among

observers (N=420) in the accuracy of their perceptions of classmates’ relationships, however the majority of observers exhibited greater-than-chance levels of accuracy (Mean κ =0.371). To better understand observers’ accuracy, we separately examined their observations of three subpopulations of targets. Not surprisingly, the mean accuracy of observers when observing targets composed of two children with whom they do not hang out was low (Mean κ =0.348). However, the mean accuracy of observers, when observing targets composed of two children with whom they hang out, was even lower (Mean κ =0.185). The mean accuracy of observers, when observing dyads composed of one child with whom they hang out and one child with whom they do not hang out, was in the middle of these two extremes (Mean κ =0.258).

There was also substantial variation among targets (N=5640) in the accuracy with which they were perceived, and surprisingly many of them were perceived with worse-than-chance accuracy (Mean κ =0.105). The results presented below explore factors associated with this variation: why were some observers better at seeing relationships, and why were some targets easier to be seen by others?

3.1. Observer and target accuracy

To examine predictors of observer accuracy, we estimated an ordinary least squares regression, using cluster robust standard errors to adjust for potential clustering by classroom (Rogers, 1993; see Table 2). These results indicate that children in higher grades and smaller classrooms were more accurate observers of classmates’ relationships, lending support to H1A and H2A. However, in contrast to H4A, we found no association between observers’ accuracy and perceived popularity. Although we offered no specific hypothesis concerning the role of gender, our results indicate that girls were significantly more accurate observers of classmates’ relationships than boys.

To examine predictors of target accuracy, we estimated an ordinary least squares regression, using grouped dyadic standard errors to adjust for potential clustering by classroom and

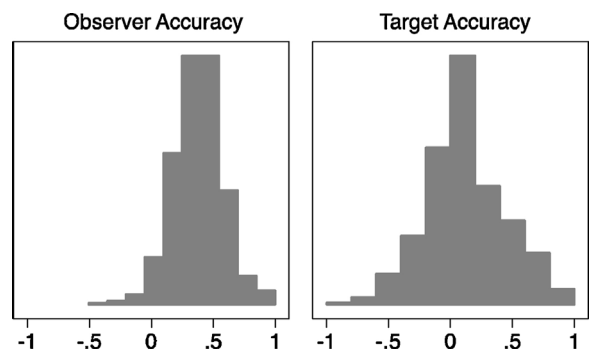


Fig. 1. Distribution of observer and target accuracy.

Table 2
Predictors of observer accuracy.

Variable	B	SE
Grade	0.053*	0.025
Class size	−0.009*	0.004
Female	0.048*	0.019
Perceived popularity	−0.023	0.030
Intercept	0.386**	0.103
R ²	0.109	

N=420 observers; * $p < .05$, ** $p < .01$ using cluster robust standard errors.

non-independence by dyad (Fafchamps and Gubert, 2007; see Table 3). These results provide support for all of our hypotheses related to target accuracy (H1B, H2B, H3, H4B, and H4C), indicating that targets (i.e. pairs of children) were more accurately observed when they occurred in smaller classrooms of higher grades and involved same-sex, high-popularity, and similar-popularity children. Interestingly, not only were same-sex targets more accurately observed than mixed-sex targets, but among same-sex targets, GIRL–GIRL targets were more accurately observed than BOY–BOY targets.

4. Discussion

Advances in developmental research have highlighted the importance of classroom peer relationships for understanding both positive and negative childhood behaviors (e.g., Farmer and Xie, 2007; Kindermann, 1993). However, how children perceive these classroom relationships may be more important than the relationships themselves in guiding behaviors that yield intended outcomes (Krackhardt, 1987, 1990). To date, less is known about children's perceptions of their classroom relationships, especially what predicts the accuracy of these perceptions. Moreover, the past research that has explored accuracy has focused only on observers (i.e., seeing), but there is limited information on targets (i.e., being seen). Therefore, this study attempts to fill empirical gaps in the literature on children's interpersonal perception by exploring the predictors of accuracy, for both observers and targets.

4.1. Empirical implications

Aligning with developmental research suggesting that children in higher grades experience increased social cognition (e.g., Dodge and Price, 1994) and more stable relationships (Gifford-Smith and Brownell, 2003), observer and target accuracy increased as grade level increased. Smaller class sizes also predicted increased observer and target accuracy. That is, children in smaller classes more accurately see, and are more accurately seen in, relationships. As a set, these results are consistent with past studies using different measures of observer accuracy (Cappella et al., 2012; Malloy et al., 1996, 2007), and add to the literature by demonstrating that grade and class size also play a role in target accuracy.

Table 3
Predictors of target accuracy.

Variable	B	SE
Grade	0.043**	0.012
Class size	−0.007**	0.002
Boy–Boy	0.097**	0.031
Girl–Girl	0.177**	0.022
Mean PP	0.214**	0.042
Diff. PP	−0.102**	0.030
Intercept	0.105	0.056

N=5640 targets; ** $p < .01$ using grouped dyadic standard errors.

Although gender findings in prior research have been mixed with respect to observer accuracy (e.g., Cillessen and Bellmore, 2011), this study found that girls were more accurate observers of classmates' relationships than boys. In middle childhood, girls tend to focus more heavily than boys on social relationships and relational goals like maintaining friendships and mutual participation (Rose and Rudolph, 2006). These foci may lead girls to exert more attention than boys to who associates with whom in the classroom, resulting in higher levels of accuracy. Additionally, this study found that relationships between pairs of same-sex children were more accurately observed than those between pairs of mixed-sex children. This result is not particularly surprising given that mixed-sex relationships are rare in middle childhood (e.g., Maccoby, 1998). Indeed, in the current study sample, only 19.1% of reciprocated, self-reported "hanging out" relationships were mixed sex. Moreover, from an early age, children hold expectations that their peers affiliate with members of the same sex (e.g., Martin et al., 1999; Neal et al., 2014). The finding that relationships that conform to children's gender expectations (i.e., same-sex pairs; Martin et al., 1999) are more accurately observed, suggests that accurate interpersonal perception may be subject to cognitive schemas about who hangs out with whom. Interestingly, relationships between pairs of girls were more accurately observed than relationships between pairs of boys. These findings may partially be explained by gender differences in play styles, especially during middle childhood. For example, in middle childhood, boys tend to play in large groups while girls engage in longer duration, dyadic interactions that favor social conversation (see Rose and Rudolph, 2006). These differences may make it easier for observers to distinguish pairs of girls who hang out together.

Despite anticipated links between social status and interpersonal perception, children with higher levels of perceived popularity were not more accurate in their perceptions of classmates' relationships. However, perceived popularity was linked to target accuracy. Relationships were more accurately observed when members had a higher mean level of perceived popularity, perhaps because relationships between higher status classmates are particularly socially salient. Attending to these high status relationships may also be socially adaptive for observers looking to navigate and/or climb the classroom social hierarchy. Additionally, relationships were more accurately observed between dyads of with similar levels of perceived popularity. Because children tend to affiliate with similar status peers (Farmer et al., 2009), relationships that run counter to this norm may thwart expectations and children may exhibit perceptual biases that make these relationships more difficult to observe.

4.2. Methodological implications

In addition to the empirical implications reviewed above, this study also offers methodological implications for understanding children's classroom relationships. This study demonstrates considerable variation in both observers' accuracy in perceiving classmates' relationships and targets' accuracy in being perceived by classmates (see Fig. 1). Furthermore, in some cases, observer and target accuracy was worse than expected by chance. These findings have implications for the measurement of children's classroom relationships. Many developmental researchers rely on peer-reported techniques such as social cognitive mapping (SCM; Cairns and Cairns, 1994) and cognitive social structures (CSS; Neal, 2008) to assess the structure of children's classroom relationships, often because direct observation is infeasible (Marsden, 1990; Neal and Kornbluh, 2016). These approaches have two sources of potential bias. First, as with any data collection instrument, there is the risk that respondents will misunderstand the questions or instructions, which may be especially likely when collecting data from

younger children. Minimizing this form of bias begins with careful instrument design and question wording, followed by pilot testing and cognitive interviews (Borgers et al., 2000). Second, both SCM and CSS involve triangulation across observers to assess classroom relationships, but typically treat all observers and reported relationships as equally accurate, which our findings suggest is inappropriate. While development of a formal model is beyond the scope of this paper, a data aggregating scheme that assigns greater weight to the observations of high-accuracy observers, and of highly-accurately observed targets, may be promising. This approach may be particularly useful in the context of cognitive social structures data, where it might involve two steps. First, as we have done here, the reciprocated self-reported relationships of participants can be compared to the participants' perceived relationships *among other participants* to obtain accuracy-based weights for both observers and targets. Second, these weights can then be used to aggregate participants' perceived relationships *among all children in the setting, including non-participants*.

The current study's demonstration of variation in observer and target accuracy also has implications for the assumptions of stochastic actor-based models (Snijders et al., 2010). These models have become increasingly prevalent in developmental research due to their ability to disentangle the effects of peer selection and socialization on childhood and adolescent behavior (Veenstra et al., 2013). However, stochastic actor based models assume that children and adolescents have accurate knowledge of the relationships in a setting. Our findings suggest that this assumption is violated, in some cases, quite severely. Two examples from our data serve to illustrate. As an observer, one 2nd grade boy in a 25-student classroom achieved a Cohen's κ accuracy of only 0.024, suggesting his perceptions of his peers' relationships were little better than guesses. He had a false-positive rate (i.e. identified a relationship when none exists) of 31.7%, and a false-negative rate (i.e. failed to identify a relationship when it exists) of 65%. Similarly, a target in the same large 2nd grade classroom, a relationship between a popular girl and unpopular boy, was correctly identified as present by less than 15% of their peers, yielding a Cohen's κ accuracy of only 0.05. Combining these two examples and perhaps not surprisingly, the unreliable 2nd grade boy observer was among those who failed to see the relationship between these two peers.

Precisely how much knowledge actors must be assumed to have depends on the specific types of effects these models are used to estimate. Snijders et al. (2010) suggest that in practice "the actors only need more limited information" because the basic and triadic effects commonly estimated depend only on the actor's personal network (i.e. the relationships of those directly connected to the actor). This implies that as long as children are reasonably accurate in their perceptions of their own friends' relationships, the practical assumptions of stochastic actor-based models may still be satisfied. However, we found that children lack even this more moderate form of accuracy. Children are less accurate observers of their own friends' relationships than of relationships between non-friends. This finding may seem counterintuitive, but is consistent with expectations from balance theory (Heider, 1958). When making inferences about the relationship between two individuals with whom an observer hangs out, even in the face of missing or contrary information, the observer expects them to also hang out with each other. Indeed, this is precisely what we observe in these data: a high false-positive rate (49.9%) when children are reporting on relationships between two of their friends.

The levels of accuracy illustrated in Fig. 1, together with the examples above, highlight that some observers are not particularly good at seeing, and some targets are not particularly good at being seen. Moreover, the auxiliary analysis demonstrates that children are no more accurate, and indeed may be less accurate, in their perceptions of their own personal networks. These findings

suggest that using a stochastic actor-based model to study the social networks of children may violate critical assumptions of the model, even when attempting to estimate only triadic effects. Therefore, developmental researchers should carefully consider whether it is appropriate to employ stochastic actor-based models in this population. Future work in this area should focus on identifying, perhaps through simulation, the impact that different degrees of perceptual error have on estimates obtained from stochastic actor-based models. If the degree of perceptual error we observe here has a large impact, it may be necessary to refine these models so they can accommodate such low-accuracy conditions. Agent-based simulation models frequently include tunable parameters to control how much agents' know about their environment, or how much error is present in that information. To the extent that stochastic actor-based models "can be regarded as an agent-based simulation model" (Snijders et al., 2010, 46), this approach may offer one solution.

4.3. Limitations and conclusions

The results of this study should be interpreted within the context of some limitations. Because the current study sample was demographically homogenous, we are unable to determine whether the predictors of accuracy generalize to children from other racial, ethnic, or social class backgrounds. Likewise, we are unable to determine the role these demographic features play in forming perceptions. Also, because the current study focuses on children in a limited range of grades (i.e., second to fourth grade), additional research is needed to see whether these findings extend to other age groups. This study only assessed accurate perceptions of relationships within the classroom context, and did not consider relationships in the broader context of the school or neighborhood. Longitudinal research is needed to understand the developmental trajectory of both observer accuracy and target accuracy in perceiving classmates' relationships, and to understand how relationship stability plays a role in these forms of accuracy.

Children vary widely in their ability to accurately see classroom relationships. Moreover, certain classroom relationships are more accurately seen than others. Findings from this study explain, in part, this variation in observer and target accuracy by examining the role of grade, class size, gender, and perceived popularity. As future work continues to focus on both observer and target accuracy, we stand to gain a deeper understanding of the factors associated with children's accurate interpersonal perceptions.

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