Over the past decade, multiple strands of research have converged on the conclusion that peers play an important role in the academic success of children and youth. Two of the most prominent areas of research focus on different kinds of naturally occurring peer relationships: One examines friendships (e.g., Berndt & McCandless, 2009; see also Hartup 1995, 2009) and one examines children’s peer groups (e.g., Cairns & Cairns, 1992; Kindermann, 2007). Both have demonstrated that peers have an effect on the development of students’ academic motivation and achievement, but their target phenomena, methods, and theoretical traditions have remained largely distinct. The goal of this chapter is to begin bridging these areas in order to create a more complex and comprehensive map of the world of
peers that may be used to better guide the study of the effects of peers on the development of children and adolescents.

**FRIENDS AND INTERACTION PARTNERS**

The study of *friendships* focuses on intimate and enduring ties between students. These relationships are typically identified through children’s self-nominations of agemates whom they consider friends. To be sure that nominations reflect actual relationships (and not just one-sided preferences), friendship studies typically rely on reciprocal nominations, in which both partners agree on the nature of the relationship. Although most studies highlight negative developmental influences from friends (e.g., Dishion, Andrews, & Crosby, 1995; Ennett & Bauman, 1994; Jaccard, Blanton, & Dodge, 2005; Popp, Laursen, Kerr, Stattin, & Burk, 2008; Urberg, Degirmencioglu, & Pilgrim, 1997), a growing number find that children’s friendships in school can also exert positive effects on academic development (e.g., Altermatt & Pomeranz, 2003; Hallinan & Williams, 1990; Kandel, 1978; Ladd, 1990; Ladd, Kochenderfer, & Coleman, 1997; Ryan, 2001; Wentzel, McNamara-Barry, & Caldwell, 2004; for a review, see Bukowski, Motzoi, & Meyer, 2009). Especially noteworthy for our chapter is the research program of Tom Berndt and colleagues on the effects of friendship on students’ school motivation and achievement (e.g., Berndt, 2004; Berndt & Keefe, 1995; Berndt, Hawkins, & Jiao, 1999; Berndt, Laychak, & Park, 1990).

The study of *peer groups* focuses on broader groups of frequent interaction partners (e.g., Cairns & Cairns, 1992; Furman, 1989; Kindermann & Gest, 2009). Unlike friendship research, most work in this area does not rely on self-reports of relationships. Instead, it employs a method called *socio-cognitive mapping* (SCM; developed by Robert Cairns and colleagues: Cairns, Perrin, & Cairns, 1985; Cairns, Gariépy, & Kindermann, 1990). Multiple students are interviewed as “expert” participant observers of everyday interactions in a setting, and report the groups of agemates who tend to “hang around” with one another. Students are asked to list all the groups they know, candidates can be in more than one group at the same time, and groups can be as small as dyads. The goal is to identify subgroups of frequent interaction partners. Like friendship studies, SCM studies also suggest that peers influence motivation and behavior in school (e.g., Cairns, Neckerman, & Cairns, 1989; Chen, Chang, & He, 2003; Farmer, Cairns, & Cairns, 2002; Gest, Rulison, Davidson, & Welsh, 2008; Kindermann, 1993, 2007; Kindermann, McCollam, & Gibson, 1996).

Although both friendship and peer group studies focus on peer relationships, they do so from different theoretical and methodological angles, focusing on different kinds of peers using different kinds of methods.
Prolonged study of peer influences has led to increased appreciation for the complexity of the peer worlds that students inhabit, and there have been calls for theoretical development and elaboration within these areas (e.g., Cairns et al., 1989; Furman, 1993). Nevertheless, research on different kinds of peer relationships has proceeded down largely unconnected avenues. Our primary goal is to instigate a debate about how to integrate areas of research relevant to the study of peer influences on children’s and adolescents’ academic development in school.

The Tensegrity Metaphor

If we want to capture the peer world of children in school, a larger perspective may be helpful that can accommodate multiple kinds of peer relationships and that can allow for the study of their similarities, differences, and potential overlap, both in composition and in their effects on development. The current paper was inspired by the potential of the idea of tensegrity to offer a guiding metaphor for integrating multiple perspectives on the world of peers. “Tensegrity” is a term coined by Buckminster Fuller as a composite of the constituting features of “tension” and “integrity” in structural designs. Tensegrity structures have been publicized by sculptor Kenneth Snelson (Whelan, 1981); the key ideas have been used by medical and biological researchers as well as architects (for a review, see Conelly & Back, 1998). Tensegrity follows the idea that in a given structure “muscles” can exist independently of a “skeleton” and that both components work together to give the structure flexibility while they hold it together at the same time. A simple form is a kite in which two bars are held together by wires across their ends. Figure 3.1 gives the example of a

Figure 3.1 The Tetrahedon as an example of a tensegrity structure (www.kennethsnelson.net; reprinted with permission from the artist).
tetrohedron (taken from Snelson, www.kennethsnelson.net). Bars (or struts) and wires (or cables) work with each other to hold the structure together; they simultaneously push each other apart and pull each other together, maintaining a strong but flexible structure. If outside pressure is applied, the structures can adapt and change their form, but they regain their original form when pressure recedes. (More complex structures can be found at www.springie.com.)

Tensegrity may be taken as a theoretical analogy for peer group studies. One consequence of this analogy would be to ask whether, in social networks, there may be different kinds of interconnections among people that have different functions, but nevertheless all work together to form structures that are more complex (and flexible) than static grids. For example, close and intimate friendships may be interwoven with groups of peers who are not necessarily friends but regularly interact with one another at school—for example, in joint activities. Thus, it could be that friendships, because of their intimate nature, are more sturdy and stable, while peer group affiliations would be more flexible and fluid. In this case, both components would not be materially different but just differentially flexible. Alternatively, peers who are both friends and members of the same peer group may be important for holding a network together (struts or skeleton), whereas peers who are only friends or only members of a group (but not the other) may be more influential over time because they both may be able to exert more tension (wires or muscles). These two kinds of affiliations would not be redundant; instead they would be interconnected parts of the peer system and jointly influence people’s development.

A second consequence may be to reexamine how we conceptualize social networks. Borgatti, Mehra, Brass, and Labianca (2009) identify several fundamental metaphors or models of how social networks are conceived in social network analysis (SNA): Most prominent are the flow model, the interaction model, and the social relations model. Flow conceptualizations regard a network as a system of “pipes” that transmit information from one person to another and constitute exchange relationships. Interaction and relations models regard networks as structures in which interpersonal connections create borders, distinctions, social roles (as defined by various network topologies), and social influences. The concept of tensegrity may be helpful for combining these metaphors (e.g., the skeleton of an organism or network serves different functions than its nervous system or its muscles; for a discussion see also Ingber, 2003). Or, to the functions of static connections among people in a network, tensegrity may add the notion of tension (e.g., exerted by wires that apply pressure to hold the structure together).
Application of Tensegrity to the Study of Peer Influences on Academic Development

The key insights from the tensegrity analogy are that there may be multiple kinds of connections between peers (i.e., bones and muscles, or friends and frequent interaction partners), and that these connections may have multiple features—some are architectural or topological features, as described by structural or compositional characteristics, and some would be flow or functional features, as described by the influence of the different kinds of peers on the academic development of children and youth.

Such an analogy is helpful in describing complex peer relationships under one condition—namely, as long as there is partial overlap between friends and frequent interaction partners. In other words, the sets of peers captured by reciprocal friendship nominations and those captured by SCM would be neither exactly the same nor completely different peers. If they are exactly the same sets of peers, then no distinctions between them are needed; if they are completely different, there is less need for models that integrate them. The few studies that have directly compared friends and peer groups in terms of membership suggest that, consistent with the tensegrity analogy, there is some overlap between peers who are friends and those who are frequent interaction partners, but they are not identical. Cairns, Leung, Buchanan, and Cairns (1995) found that at two time points during a school year, only about half of children’s self-nominated friends were also members of their (SCM) peer group networks; nevertheless, overlap increased across the school year (there was 52% overlap halfway through the school year, and 82% overlap near the end of the year). Gest, Moody, and Rulison (2007) found fewer than 50% of the members of children’s SCM groups to also be mutual friends; conversely, children who were friends did not necessarily affiliate in groups. Rodkin and Ahn (2009) report kappa agreement scores of .48 and .53 between SCM group networks and self-reported friendships.

At the same time, research suggests that there are compositional similarities between friends and frequent interaction partners. Affiliates of both kinds are relatively homogeneous in terms of their academic characteristics. For example, friends are more similar than non-friends in their academic achievement and motivation (Berndt et al., 1999, 2009; Bukowski et al., 2009), and peer group members are also more similar than non-group members in how their academic motivation manifests itself in the classroom (i.e., in engagement; Kindermann, 1993, 2007). There also seem to be functional similarities. For example, the characteristics of students’ friends and those of the members of their peer groups seem to have similar power in predicting changes in students’ own school motivation over time (Berndt et al., 1999; Kindermann, 2007). However, the specific mecha-
isms of influence are assumed to be different (e.g., Kindermann & Gest, 2009; Wentzel, 2009). Friendship research builds on the assumption that important peer partners are those who share emotionally close, stable, and long-lasting relationships with a student. SCM network approaches focus on the frequency of social interactions, following the assumption that such interactions are the “engine” of development (Bronfenbrenner & Morris, 2006). According to this perspective, from frequent interactions, close relationships may or may not develop (e.g., Cairns et al., 1989).

The current chapter explores the idea that both kinds of affiliations show substantial but far from perfect membership overlap, that they may be genuinely different phenomena with their own attributes and compositional features, and that they nevertheless should work synergistically in influencing students’ academic development. The goal is to compare students’ reciprocal friendships with their observable peer groups in an existing data set that includes an entire cohort of sixth graders in a small town (Kindermann, 2007).

**Focus on Classroom Engagement**

The target feature of academic development in this chapter is students’ engagement in the classroom (Fredricks, Blumenfeld, & Parks, 2004). In this context, engagement refers to students’ active, enthusiastic, constructive emotionally positive participation in learning activities in the classroom. It can be contrasted with disaffection, which refers to passivity and withdrawal or to involvement in classroom activities that is half-hearted, anxious, or disruptive (Connell & Wellborn, 1991; Skinner, Kindermann, & Furrer, 2009). Engagement is a key marker of academic success, predicting students’ learning, achievement, retention, and eventual school completion (e.g., Jimerson, Campos, & Greif, 2003; Skinner, Zimmer-Gembeck, & Connell, 1998). It also seems to be a protective factor against the risks of adolescence, including dropout, delinquency, substance abuse, and risky sexual behavior (O’Farrell & Morrison, 2003). Engagement and disaffection are critical to the dynamics of motivational and academic development (Skinner, Kindermann, Connell, & Wellborn, 2009; Skinner, Furrer, Marchand, & Kindermann, 2007). As a motivational construct, engagement captures the outward expression of a student’s academic motivation, how it is enacted in the real world. As such, we see the construct as an indicator of the extent to which the (internal) motivational state of a student becomes visible to others and influences interactions. Although a great deal of work has focused on how teachers shape the development of student’s engagement (Wentzel, 2009), much less research has examined the role of peers.
Structure and Nature of Friendships and Interaction Partners

The tensegrity analogy suggests that distinctions between several components of a network may be important, which focuses researchers on the structure, membership, and composition of the different kinds of peer relationships. A first expectation guiding this study was that there would be overlap between friends and peer group members, but overlap would be far from complete, indicating that networks of close friends are not necessarily identical to groups of frequent interaction partners. A second expectation was that the motivational composition of the two kinds of relationship partners would nevertheless be similar. Thus, following previous research on peer homogeneity, we expected that friends would be more similar than non-friends in their engagement, and that peer group members would also be more similar than non-peer group members.

However, the two kinds of relationships should also differ. An attribute likely to differentiate them is subjective relationship quality, with children likely to feel closer to peers they nominate as friends than to those with whom they interact but do not consider friends. This suggests the utility of examining different combinatorial subsets of peers, such as peers who are both friends and frequent interaction partners, compared to peers who are frequent interaction partners but not friends. In addition, there will be peers who are friends but are not known to engage in public interactions at school. For example, children may share friendships that are purposefully kept less visible to the general public (e.g., cross-gender friendships and romantic affiliations at an age when public interactions are largely gender segregated); some children may also be friends outside of school, even though in school, they would prefer to interact more with other agemates than these friends.

Functions of Peers

Finally, the tensegrity analogy suggests that the functional features of a system are also important, which focuses researchers on the effects of different kinds of peer relationships on academic development. It is important to note a required design feature for studies of peer influence: They need to examine the effects of peers on changes in target outcomes over time; social influences from peers need to lead to changes in individuals. Hence, the third expectation was that, despite their membership and compositional differences, each kind of peer context would nevertheless show similar contributions to changes in children’s academic motivation across the school year. The fourth expectation was that a combination of both contexts would lead to better predictions of changes in engagement than either context independently, indicating synergistic effects. Such findings would be theoretically most interesting because they would highlight the benefits that can result from combining multiple approaches to studying peer affiliations.
METHOD

The study is a re-analysis of Kindermann’s (2007) study on social network influences on school motivation in an entire cohort of sixth graders in a rural/suburban northeastern U.S. town. The school was the only public school in town for this age group; the next town was about 3.5 miles away. Out of the total of 366 students in the town (48% girls), nearly all participated (340, 93% had parental permission and consented themselves2). As in most U.S. school districts, sixth grade was the beginning of middle school, so students had just moved into a new building on the school grounds. Middle school was organized in homerooms, so that students had one class scheduled together each day; other classes varied in composition. All 13 homeroom teachers participated, and all stated that they were very familiar with the students’ academic development.

Design and Measures

Student and teacher questionnaires were administered within the first two months during the first year of middle school (September–October), and within two months of its end (May–June).

Academic engagement was assessed using a 14-item scale that tapped teacher perceptions of students’ behavioral and emotional engagement (Wellborn, 1991; e.g., “In my class, this student works as hard as he/she can”; “this student appears happy”). The two components are moderately intercorrelated, form an internally consistent and highly stable indicator of engagement, and are moderately correlated with grades and achievement (Skinner & Belmont, 1993; Skinner, Wellborn, & Connell, 1990; Skinner et al., 2009). In fall of sixth grade, teachers provided information on 318 students (87% of the population); in spring, reports on 322 students were obtained. Three hundred students had assessments at both time points.

Friendships

At the beginning of sixth grade, students were asked to nominate their three best friends in each of three contexts: in class, in school, and outside school. The goal was to capture all existing friendships of the children in the town, even those that were not based in school. A total of 314 children (86% of the cohort of 366 students) reported on their friendships, about half of them from each gender (48% girls). On average, students listed about 10 friends (one student nominated 17); 311 listed at least one friend, and 294 listed at least one friend who was identified in the school’s grade rosters. A total of 3005 listed friends were identified using class and school rosters (ambiguous nominations were mostly settled by combining friend
with SCM reports; e.g., in cases of misspellings or nicknames). Names of participants who were not reliably identified, names of nonparticipants, illegible nominations, and nominations denoting adults were dummy-coded (440 nominations, 13% of all nominations).

A total of 911 reciprocal friendships were identified, denoting that roughly every fourth nomination received reciprocation. Nominations for friends in class, in school, and outside of school were combined because agreement on the “location” of friendships was relatively low. This underestimates the actual amount of friendships in the town for two reasons: 13% of self-reported friends were students from other grades or were not identified (some are likely agemates who attended private schools in the vicinity or commuted to nearby towns), and those could not be reciprocated; 55 students (15% of the cohort) did not participate or did not report any friends, although about half of them received nominations from others; again, no reciprocity was possible.

**Relationship Quality**

Along with their friendship nominations, students were asked to indicate the quality of the friendship they felt with the respective nominee (on a scale from one to three, from “sort-of a friend” to “very good friend”). As a measure of the quality of reciprocal friendships, the average was taken of the ratings of each child in the dyad. This measure may be seen as an index of mutual closeness in the friendships.

**Peer Group Networks**

At the beginning of sixth grade, students were also asked to list those groups of agemates whom they observed to frequently “hang out” with one another. Students were asked to list as many groups and members as they knew (in and out of school), to include dyads, to include themselves, and to include the same children as members of different groups if that was appropriate (thus, a report could indicate that A, B, and C form one group, and that B and E form another). The questionnaires provided spaces to list up to 20 members of up to 20 groups (more detailed descriptions of SCM methods can be found in Cairns et al., 1990). None of the students exhausted the space, but several listed groups of 15 members.

**Network Identification**

280 students (76% of the cohort, 56% girls) provided information about peer group networks in sixth grade. Non-identified (e.g., illegible) candidates, teachers, and family members were dummy-coded (10%). Because reporters did not just report about their own groups but about groups they observed in their entire grade, network reports included participants as well as nonparticipants (as well as some children from different grades if
those were in groups with sixth graders, e.g., in sports teams or outdoor activities). A total of 3,047 group members were reported for a total of 694 peer groups, containing 2 to 15 members. A typical child nominated 2.67 groups with an average of 4.4 members.

The goal was to identify, for each student, those agemates who were known to be members of his or her peer group. The nominations were arranged in a co-occurrence matrix denoting the numbers of times that pairs of students were reported to be in the same group (across 6th grade, see Kindermann, 2007). Binomial $z$-tests examined whether conditional probabilities of finding a specific student within the group of another student were higher than could be expected by chance. For example, out of 36 observations in which a student A was observed to be in a group, student B was found to be in the same group 28 times. The conditional probability of finding B, given that A had a group ($28/36 = .78$), was compared with the unconditional probability with which B was found in all 694 groups ($32/694 = .05$). The resulting $z$-score of 21.47 is highly significant and denotes that B was in A’s peer group. The program NetJaws (Mehess & Kindermann, 2009: http://web.pdx.edu/~thomas/measures.html) was used to identify significant connections ($p < .01$; connections based on single co-nominations were not accepted; usually, these were just self-nominations). Because expected frequencies were often lower than recommended for the approximation to the normal distribution, Fisher’s exact tests were used in addition (using Sterling’s approximation; von Eye, 1992), and connections were only accepted when both tests were significant.

Based on the tests, a composite social map was formed of all network connections in sixth grade (the map can be viewed at http://web.pdx.edu/~thomas/). Overall, the individual informants’ reports were highly consistent with the composite map (average $kappa = .88$) when only errors of commission were considered. (Errors of omission were not considered because it seems unrealistic to expect that every informant would know the same about every peer group in the school.) The high observer reliability indicates that the resulting composite map fits the data adequately.

**Peer Group and Friendship Network Engagement Profiles**

For each student, individual peer context profile scores were formed. Thus, a student’s peer group profile was the average of the individual engagement scores of this student’s peer group members; the students’ friendship network profile was the average of the engagement scores of his or her reciprocal friends (the student’s own score was not included). This was done separately for behavioral and emotional engagement. Basic analyses used engagement profiles of students’ peer groups and friendship networks. More detailed analyses used combinatorial subsets (e.g., the engagement profiles of students’ peer group members who were also reciprocal friends).
RESULTS

The results are presented in three parts. First, the proportions are presented of the different kinds of context agents (reciprocal friendship networks, peer groups, and the overlap of both contexts) that children had in sixth grade. Second, homogeneity of peer groups and friendship networks are calculated with regard to classroom engagement. Finally, analyses examine the extent to which both peer contexts have synergistic effects on change in students’ motivation. Analyses were conducted using SEM (Amos 5; see Arbuckle, 2003), using its Full Information Maximum Likelihood (FIML) algorithm for missing value estimations.

Overall, description of the results will be general and pay relatively little attention to gender differences. Research shows that friendship networks and peer groups tend to differ for girls and boys, and gender differences in academic characteristics are ubiquitous in school. However, it is less clear whether, beyond gender segregation at this age range, gender differences in peer contexts mean much for academic development; boys and girls, despite their differences, do not seem to change differently over time (for a discussion, see Crosnoe, Riegle-Crumb, Field, Frank, & Muller, 2008). Thus, the main analyses do not focus on interindividual differences but on the general composition of peer group and friendship network contexts and on the differential contributions that both contexts can have for motivational development in school. Student gender will be controlled in most analyses.

Description of Peer Contexts

Reciprocal Friendship Networks

Two hundred ninety-four students (94% of participants; 80% of the entire cohort in the town) listed at least one friend in the town, and 289 had at least one reciprocal friend (79% and 87% of participants). Only 27 children had none. On average, a child had 2.7 reciprocal friends (ranging from 0 to 12); about half (53%) were from the same homeroom, and almost all were of the same sex (97%; note, though, that at least 20 children had cross-gender friendships and that there could have been more if 5th and 7th graders had been included).

Peer Groups

Students can have members in their peer groups who did not participate themselves as reporters, because SCM assesses public knowledge, over and above self-reports. A typical sixth grader had 4.9 agemates in his or her peer group (with a range from 0 to 17); 286 (78% of the cohort) had at least one
agemate as a member of their peer group(s). Group members were almost entirely of the same sex (94%) and more than half (60%) were classmates from the same homeroom. Nearly all peer group members (98%) were from the same grade.

**Peer Context Interrelations and Overlap**

Students with many reciprocal friends also had larger peer groups ($r = .37, p < .001$), suggesting some similarity of the contexts. Nevertheless, both contexts did not consist of the same individuals. As Figure 3.2 shows, about half of a student’s reciprocal friends were also members of his or her peer interaction network (52%), but only about a third of a students’ peer network members were also his or her reciprocal friends (29%).

Thus, the two context measures are not just alternative assessments of the same underlying context construct, but represent different kinds of contexts. This can also be seen by looking at students who did not report that they had friends, were not chosen as friends, or had no network membership. Twenty students did not list a friend; however, they nevertheless received an average of 2.7 friendship nominations (ranging from 0–7) and were members of peer groups with an average of 2.1 members (range 0–8). Similarly, children who received no friendship nominations ($N = 14$) nevertheless nominated an average of 3.5 friends (range 0–9) and had peer groups with about 2.9 members (range 0–13). Children without reciprocal friends ($N = 27$) still had an average of 3.5 self-nominated friends (range

---

**Figure 3.2** Overlap between the members of a 6th grader’s peer group (G) and his or her group of reciprocal friends (F).
0–9), received 2.14 nominations (range 0–7), and had 3.14 members in their peer groups (range 0–13). Conversely, students without a peer group (N = 55), still nominated 4.3 friends (range 0–11), received 3.1 nominations (range 0–10), and had 1.3 reciprocal friends (range 0–6). Finally, even children without any kind of indication for a friendship (N = 6) were, on average, members of at least one peer group dyad (range 0–5).

**Homogeneity of Peers’ Motivational Profiles**

Although friendship networks and peer groups consisted of largely different individuals, the contexts were nevertheless similarly homogeneous in terms of members’ engagement levels. Individual students were as similar to the members of their peer groups ($r = .44$, $p < .001$) as they were to their friends ($r = .33$, $p < .001$). Thus, group member and friend selection processes seemed to follow similar criteria with regard to academic motivation. We do not assume that peer selection processes specifically targeted motivation levels of candidates, but rather that selection processes tend to follow a variety of interindividually different criteria (e.g., student interests, schedules). Some of the criteria are likely facilitative of academic motivation whereas others may not be.

**Relationship Quality**

Differences in relationship quality were expected between the two contexts (following Berndt, 2004). To examine this, a participant’s own rating of the quality of his or her reciprocal friendship with an agemate was averaged with the closeness rating that the participant received from the friend; then, the average was taken across all of that child’s friends. Three relationship quality indices were formed for each student. For example, student A’s closeness towards those of her **reciprocal friends who were also members of her peer group** was the average of her own ratings of “how good a friend” these friends were and of the ratings she received from each friend. Similarly, A’s closeness towards her **friends who were not members of her peer group** was the average of her own closeness ratings towards these peers and of the closeness ratings she received from these peers. Finally, because peer group membership was determined from peer observations (and not from self-nominations), there were no closeness ratings for those **members of a student’s peer group who were not reciprocal friends**. However, for a typical student, about half of these were (non-reciprocally) nominated as friends or had issued friendship nominations for that student, and their average was used.

As expected, relationships of highest quality existed among those peer group members of a student who were also his or her reciprocal friends (2.43 on the 3-point scale). Less close were relationships among friends who were not peer group members at the same time (2.20), and even less close were relationships with peer group members who were not friends (1.97; F
(208,1) = 36.34, \( p < .001 \); the differences were weaker when student gender was controlled but differences did not consistently favor girls or boys).

This was taken as suggesting that three peer contexts needed to be distinguished: friendships within peer groups of frequent interaction partners (G&F), friendships outside of peer groups (F–G), and peer groups that did not contain friendships (G–F). This matches with observations in a classroom of fourth and fifth graders (Kindermann & Sage, 1999) in which interactions during classroom lessons (and short breaks) were most frequent between a child and those members of that child’s peer group who were also his or her friends. Thus, if there are two pathways of how peer influence can come about, namely, through relationship factors (e.g., emotional support, interpersonal attraction) and interaction factors (e.g., frequency of joint activities, instrumental support, learning from one another), friends who are also members of a child’s group of frequent interaction partners combine both benefits and can be expected to be most influential.

To summarize, in terms of their composition, students’ peer groups and friendship networks appeared to differ in several ways: They differed in size, consisted of fairly different individuals, and exhibited different levels of relationship quality. At the same time, however, a child was as motivationally similar to the members of his or her friendship network as to the members or his or her peer group.

**Peer Influences on Classroom Engagement**

The third part of analyses examined the functions that peer groups and friendship networks may have for motivational development over time. In a first set of analyses, peer and friendship networks were examined separately. SEM analyses used the engagement profiles of each kind of affiliation as predictors of changes in students’ engagement across the school year. Because students’ school motivation, gender, and size of their peer group or friendship networks were correlated, gender and number of respective affiliates were controlled.

By themselves, students’ peer group profiles in the fall predicted individual change in motivation over time (\( beta = .12, p < .05 \), as reported in Kindermann, 2007). Profiles of students’ friends were as predictive (\( beta = .11, p < .05 \)). In each analysis, the respective peer context explained about 2% of the variance in changes in student motivation over the school year. This may appear small compared to the concurrent correlations (see Figure 3.3). However, it should not be considered small when one notes that engagement was highly stable over the school year and that influence effects were examined over and above stability and concurrent person-to-context peer correlations that can be assumed to denote selection effects.
In a second step, both peer context predictors were included simultaneously. Because the goal was to look at *combinations* of peer groups and friendship networks, three peer context indices were formed: engagement profiles (for behavior and emotion) of a student's peers who were peer group members, reciprocal friends who were also members of the child's peer group; reciprocal friends who were not members of the child's peer group; and reciprocal friends who were not members of a child's peer group.

![Figure 3.3](image.png)

**Figure 3.3** Peer group and friendship influences on individual students’ change in motivation across the school year.

**Notes:** $X^2(24) = 40.220, p = .020$; CMIN/DF = 1.676; CFI = .992; RMSEA = .043. The three peer relationships paths were constrained to be equal, but there was no difference in fit to the unconstrained model, $X^2 = 0.882, 2$ DF.

Em, Be: Emotional, Behavioral Engagement; Ind Eng: Individual Engagement; G&F: Reciprocal friends who were also members of a child’s peer group; G–F: Peer group members who were not a child’s reciprocal friends; F–G: Reciprocal friends who were not members of a child’s peer group.
group members and his or her reciprocal friend at the same time, engagement profiles of a student’s group members who were not his or her friends, and engagement profiles of friends who were not members of the student’s peer group.

The three peer contexts were correlated with one another (ranging from .23 to .48; see Figure 3.3), and contrary to our expectations, none was able to predict changes in engagement by itself over and above the contributions of the other two contexts. So, in a third step, the predictive coefficients for the three kinds of peer partners towards engagement were constrained to be equal, assuming that similar influence effects emerged from each context (Marsh, Balla, & McDonald, 1988). Figure 3.3 shows this model; it had an acceptable fit and there was no difference to the unconstrained model ($X^2 = 0.882, 2$ DF). Thus, it can be assumed that this model explains the data as well as the model without the constraints. We concluded that changes in engagement were predicted by the engagement levels of partners who were friends of a student and members of his or her peer network at the same time (G&F: $\beta = .08, p < .05$), as well as by individuals who were members of his or her peer network but not friends (G–F: $\beta = .06, p < .05$), and by individuals who were friends but not members of his or her peer network (F–G: $\beta = .09, p < .05$). Again, this suggests that friendship networks and peer groups, although they consist of fairly different individuals, likely have similar developmental functions.

In a fourth step, the engagement profiles of a child’s peer group members and of his or her friends were used as indicators of a higher-order latent variable that we called peer group nexus; see Figure 3.4. The rationale for this strategy was that if both peer groups and friendship networks serve similar functions with regard to motivational development, either one may be a good predictor of motivational change but their combination should be most powerful. Peer group nexus emerged as a particularly strong predictor ($\beta = .23, p < .001$) of changes in engagement, and each peer context profile was a reasonable indicator of the latent nexus variable ($X^2(30) = 51.029, p = .010; \text{CMIN}/\text{DF} = 1.701; \text{CFI} = .989; \text{RMSEA} = .044$). In total, peer nexus explained 4% of the variance in students’ changes in engagement over the school year. This was twice as much as peer groups or friendship networks were able to explain by themselves (as in Kindermann, 2007). This indicates that the different kinds of peer group affiliates can have cumulative and synergistic effects on children’s developing school motivation.

**DISCUSSION**

The primary goal of this chapter was to direct attention towards how the complex world of peers can be conceptualized and measured when studying
peer influences on children’s and adolescents’ development. For decades, researchers have been interested in how peers contribute to students’ academic development in school, but their research has followed multiple largely unconnected paths, focusing on sociometric status (e.g., Bukowski & Cillessen, 1998; Moreno, 1934), friendships (e.g., Berndt & McCandless,
2009), peer crowds (e.g., Brown, 2004), or peer networks (e.g., Cairns et al., 1985; Kindermann & Gest, 2009). The metaphor of “tensegrity” suggests that these different peers are all members of a larger peer system that includes multiple kinds of connections and potentially different functions with regard to the academic development of children and youth.

The current findings are encouraging about the utility of such a metaphor. Consistent with its implications, analyses of an entire cohort of sixth graders revealed that there is substantial overlap between students’ friends (as captured by reciprocal nominations) and their frequent interaction partners (as assessed through SCM). However, the members of these two groups are not the same. As would be expected, most of a student’s friends are also part of their peer group of frequent interaction partners (52%), but some friends are not. Also in line with expectations, some of the members of a student’s larger peer network are his or her friends (29%), but many of those peers with whom a student just “hangs out” are not his or her reciprocal friends.

Taken together, the findings suggest that the peer world contains at least three distinguishable subsets of peers: “friendship networks” consisting of friends with whom a student interacts frequently and publicly; “just friends” with whom a student is not known to interact much at school; and “just peer group members” consisting of peers who are frequent interaction partners but who do not share reciprocal ties of friendship. These three groups can be different on some characteristics and the same on others. For example, in the current study, these three groups differed in their relational closeness. As would be expected, students are closest to their friendship networks, then to their friends, and then to the members of their peer group whom they do not consider friends.

At the same time, groups of reciprocal friends and peer group members were also similar on some compositional attributes. Of interest in the present study were peer profiles of engagement, operationalized as the average engagement of a student’s group of friends (friend engagement profile) and of their peer group members (peer group engagement profile). Correlations between students’ own engagement and those of their peer profiles revealed that students are likely to have groups of friends and to belong to peer groups that are both similar to them in their levels of engagement. Children who are engaged tend to select friends and peer group members who are similarly engaged, whereas children who are disaffected tend to have friends and belong to peer groups who are similarly disaffected.

Functional analyses, in which these peer profiles were used to predict changes in individual engagement from fall to spring of the same school year suggested that each subset of peers has an impact on motivational development, and that their effects are not redundant; instead they are additive. We think that this represents a fairly accurate view of the effects of
**Will the real peer group please stand up?**

*peer influences* on individual children’s development for three reasons: The model examines longitudinal change (individuals serve as their own controls), the model controls for person-to-nexus similarity at the beginning of the school year (i.e., substantial peer group and friendship selection effects), and the model controls for gender differences in motivation (making sure that the findings are not just that girls, who are with more engaged peer groups, change more favorably than boys). The idea of a “peer nexus,” analogous to a tensegrity structure (Figure 3.1) which includes all three of the potential subsets, was used to organize analyses in a way that revealed their combined effects.

A more comprehensive picture of the nexus of peers also leads to reconsideration of the children and youth who are labeled as “socially isolated.” Children who do not have any reciprocal friendships may still be regarded by others as friends or may still belong to peer groups. Likewise, children who are not observed to belong to a group of frequently interacting peers may still have reciprocal friendships. Other combinations are also possible: For example, students who receive no reciprocal friendship nominations and belong to no peer groups could still nominate friends and be nominated as friends. In the current set of 294 students, even the 5 students who did not nominate any friends and were never nominated did actually have (on average) one frequently interacting peer dyad. In studying “social isolation,” it may be necessary to specify *which kind* of peer relationships students do not have and to rule out the entire range of relationships before concluding that a child is truly socially isolated. Of course, at some ages the absence of specific relationships, for example, reciprocal friendships, can be considered a risk factor for certain outcomes, if those relationships are really the only route toward the development of some important capacities.

**Future research on the effects of peers on academic development**

Future studies may be able to benefit from the tensegrity metaphor and may wish to further develop some of the conceptual and methodological strategies suggested in this chapter. Conceptually, the metaphor suggests that the structural characteristics of different kinds of peer relationships can be examined separately from their functional effects. Structural analyses revealed overlap between friends and peer group members as well as distinctiveness. Compositional analyses examined the characteristics of these different sets of peers, showing that some differ across groups, such as relational closeness, whereas others are similar, such as motivational homogeneity.

Functional analyses focused on whether profiles of peer characteristics, such as engagement during academic activities in the classroom, can pre-
dict changes in individuals’ academic development. Methodologically, the paper suggests a specific way to examine synergistic effects in children’s or adolescents’ world of peers: Apparently, there are similar kinds of influences that emerge from peer contexts that are overlapping and have similar developmental effects. To have the contexts compete against each other in analyses of their effects does not help because they are too similar and their effects cancel each other out. Multilevel approaches also do not help much because the contexts are overlapping and not distinct from one another. A hierarchical solution seems to work, in which the subsets of peer relations (e.g., friendship networks and groups of frequent interaction partners) are examined for their combined influences and synergistic effects. Both the engagement profiles of the members of students’ interaction networks and the characteristics of their friends are seen as indicators of a higher-order latent variable, and thus do not compete with one another but are seen as complementary in predicting individual change in engagement over time.

Other Aspects of Academic Development

One direction for future studies would be to examine the effects of peer groups on other important aspects of students’ academic development. Engagement is certainly a key predictor of school success, but other additional markers can be identified that would make good targets for study. Complementary candidates might include academic coping, an important process when ongoing engagement is disrupted by obstacles or problems (Skinner & Wellborn, 1997), as well as academic buoyancy or everyday resilience (Martin & Marsh, 2008). The engagement of a student’s peers and friends may provide an energetic resource for dealing with difficulties and challenges in school. Especially interesting targets are academic resources that emerge during early adolescence, such as self-regulated learning, academic identity, or ownership of one’s own academic progress.

Selection Processes

Although this paper focuses on the influence of peers, it is equally important to examine selection effects, or processes through which students join or leave peer groups and friendships. These processes create the peer contexts that turn out to be influential. If students who are disaffected from school tend to select other students who are disengaged as interaction partners or friends, then it is more likely that they will become even more disaffected over time. Following the tensegrity metaphor, it is possible that selection criteria and processes are different for friends compared to interaction partners, whether or not they end up producing homogeneous peer groups. It is also possible that selection processes for the two kinds of peers are closely connected. For example, friendships may emerge from frequent interactions
with peers who were originally not friends. Or as friendships fade, students may still maintain their interactions with peers who were once friends.

**Developmental Dynamics**

Taken together, selection and socialization effects seem to produce cycles in which the “rich get richer” as engaged students join more engaged peer groups, which in turn promote their engagement over time (Kindermann, 1993, 2007). If engaged friends emerge from these peer groups and become more stable emotionally close social partners, then friends may act as “glue” that keeps children involved in supportive peer groups and academic tasks in school. In contrast, if more disaffected students join more disaffected peer groups where they make friends, then the combined effects of disengaged friends and peer group members may further undermine their constructive participation in school activities. Developmentally, it is likely that different kinds of peers may be differentially important to students in different grades; perhaps, this is part of the general trend in which peers seem to become more important to students as they become older and progress farther in school.

**Building on the Tensegrity Metaphor**

For different kinds of peer relationships to be successfully integrated into a more comprehensive model, researchers will be required to think more clearly and carefully about their target phenomena: who the peers are (membership), how children get into the target relationships (selection), the characteristics of the peers at the individual and group levels (composition), and, perhaps most importantly, the nature of the pathways through which peers exert their effects on individual development (socialization). In distinguishing and combining peer relationships, some of these features will be similar across relationships and some will be different.

In the movement from more static architectural models of peer relationships to models that are more dynamic and developmental, special attention will need to be devoted to the interrelations among these characteristics of peer relationships and what they imply for mechanisms of influence and methods for identifying the “real” peer group. According to the tensegrity metaphor, the “real” peer group includes the entire peer nexus—adolescents inhabit a complex multilevel network of agemates, some of whom they are close to and some of whom they spend time with, who are loosely configured in multiple overlapping groups that change in their membership, composition, and individual characteristics as rapidly as the adolescent himself or herself is developing. As we know from other strands of research, the “real” peer group is also likely weighted by the popularity of
its members and sub-groups, as well as labeled and evaluated by the social categories used to describe its crowds and individuals.

Such a picture brings into stark relief the limitations of any specific method for capturing all of this complexity. For example, SCM approaches imply that social influence is a function of frequent interactions with peers. Hence the method focuses on observations of “who hangs around with whom” and peers are considered members of one’s group if they interact frequently. However, what exactly is meant by “frequent” interactions depends on the distributions of interactions among all peers in school. It is likely that everybody interacts with almost everybody in the same grade in some form or another during a school day. The fact that students have reciprocal friends who are not part of their publically recognized groups of frequent interaction partners suggests that some low frequency interaction partners (i.e., kids who do not hang around together in school) can still represent “real” and important relationships.

In this chapter, we have emphasized the potential differences between kinds of relationship partners, but at the same time, tried to remain cautious about reifying the distinction between friendship and peer group affiliations. The tensegrity metaphor, whether using struts and wires or bones and muscles as components, can easily be interpreted to imply that the components are composed of qualitatively different materials, which is obviously not the case with peers. The same agemates can move in and out of peer groups and reciprocal friendship relationships, and can be both at the same time. If such caveats are kept in mind, the metaphor can be helpful for conceptualizing the multiple moving parts that make up peer networks and designing studies that examine their potential differences as well as their similarities.

These insights also apply to future research about the nature of social influence itself. The tensegrity model suggests that an important first step is to consider how selection, membership, and composition of different groups might shape the pathways through which they influence adolescent development. On the one hand, since both kinds of social partners are agemates, it is clear that all traditional mechanisms of social influence (e.g., persuasion, discussion, modeling, reinforcement, pressure) should be considered as candidate processes. On the other hand, friendships are characterized by close and intimate relationships, mutual understanding, respect, and support, whereas peer groups seem to be characterized more by shared preferences for activities, similarities in interests, and enjoyment in doing things together. As a result, friendship influences may occur more through emotional channels (e.g., emotional comfort and support), whereas peer group influences may occur more through social learning processes (e.g., reinforcement). It may even be that this balance shifts as children move through adolescence, or that youth may become more differentiated
and thoughtful about which peers they rely on for which kinds of interactions and support (Zimmer-Gembeck & Skinner, in press).

At this point, we do not want to speculate too much about whether the social influences from friendship networks and peer groups occur through the same or different pathways. Perhaps the specific mechanisms will be similar and only differ in relative strength. Or, the pathways are similar but the targets differ. In the current paper, we looked at academic engagement, conceptualized as consisting of an emotional and a behavioral component. It would seem reasonable to expect that children’s friendships would be most influential for the emotional features of children’s motivated behavior in the classroom, whereas their public peer group affiliations may be more important for behavioral aspects. The tensegrity analogy suggests that different components of the peer world can differ. It does not stipulate that they always do. The metaphor suggests to researchers how to look at peer relationships, but it cannot tell them what they will see.

Overall, it is not surprising that the study of peers is currently segmented and resists integration. The complexity of the peer world can easily be overwhelming: It contains multiple members of differing closeness and frequency of interaction, consisting of many overlapping sets, which contain members with different characteristics and compositions, who are themselves developing, and whose membership is constantly changing. We hope that this chapter, in its use of a tensegrity metaphor, and the suggestions for conceptual and methodological strategies it inspired, can help contribute to building bridges across the many important areas that study the influences of peers on the academic development and success of children and youth.

**NOTES**

1. Some researchers have argued that differences in the specific peers captured by the two approaches are likely due to measurement error. If both assessment methods were more reliable, they would capture largely the same individuals. However, there is little empirical support for this assumption, since both kinds of approaches demonstrate high reliability (friendships based on reciprocity of nominations; SCM methods based on inter-observer consistency with kappa indices above .80; Kindermann, 1993, 2007). And logically, it seems clear that not all frequent interaction partners must be friends; there would be some friends with whom one would not spend a lot of time in school; for example, these may be cross-sex friendships or friendships based on non-school activities.

2. We estimate, from the numbers of non-identified lists of friends, that not more than 10% of children in this age group in town attended private schools and/or commuted to schools outside town. The numbers presented can thus be underestimations by about that amount.
AUTHORS’ NOTE

We want to thank Cécile Kindelberger from the Université de Nantes, France, for discussions of critical issues in the overlap of peer groups and friendship networks. Justin Vollet, Shawn Mehess, and Price Johnson from Portland State University deserve our thanks for their help with the literature review, data analyses, and editing.

REFERENCES


Will the Real Peer Group Please Stand Up?


Will the Real Peer Group Please Stand Up?


Author Queries:
On manuscript p. 2, you cite Estell, Farmer, Cairns, & Cairns, 2002. In your references, you have listed Estell, D. B., Cairns, R. B., Farmer, T. W., & Cairns, B. D. (no year given). Is that the work you mean? If so, please check the order of the authors and add the date in your references.

On ms p. 6, you cite Bronfenbrenner & Morris, but it is not listed in your references. Please add.

On p. 7, you cite Fredricks, Blumenfeld, & Parks, 2004, but in your references, the 3rd author’s name is spelled Paris. Please check the spelling and make the citation and reference match.

On ms p. 8, you cite Skinner, Furrer, Marchand, & Kindermann, 2007, but in your references, the work by that author is from 2008. Is that the work you mean to cite? If so, please make the citation and reference match.


On ms p. 12, you cite Mehess & Kindermann, 2009, but it is not listed in your references. Please add.

On p. 12, you cite von Eye, 1992, but it is not listed in your references. Did you intend to cite von Eye, 1990?

On p. 26, you cite Zimmer-Gembeck & Skinner, in press, but it is not listed in your references. Please add.

Please give a year for Estell et al. in your references (see query #1).
