Measuring Social Capital: Accounting for Nested Data and Subnetworks Within Schools

Meghan Condon[1] · Lesley Lavery[2] · Par Jason Engle[3]

Abstract Social capital is a central concept in social science research, and it is measured in diverse ways. Few measurement approaches take the network structure of complex institutional settings into account. In this study, using data from a large-scale school-based randomized field trial, we develop several factor analytic models to test the validity and reliability of a new survey battery capturing multiple dimensions of social capital in such settings. We demonstrate that it is important to account for institutional and network structure in social capital measures, and we show how social capital can be operationalized as the shared variance between different relational characteristics in complex settings with multiple subnetworks.

Keywords Social capital · Education · Factor analysis · Social networks · Schools

1 Introduction

Social capital is a central concept in social science and education research. Numerous scholars have worked to explain the variation in social capital across and within schools and other institutional contexts, and to understanding its consequences for child development and learning (Bronfenbrenner 2002; Bryk and Schneider 2002; Carbonaro 1998; Coleman 1990a, b). Less attention has been given to the measurement of social capital, and there is no consensus in the field about what constitutes a valid, reliable measure within schools (Woolcock 1998; Morrow 1999; Burt 2000).

✉ Meghan Condon
mcondon1@luc.edu

1   Loyola University Chicago, Chicago, IL, USA

2   Macalester College, Saint Paul, MN, USA

3   University of Wisonsin-Madison, Madison, WI, USA

We raise a concern about many of the existing measurement strategies: as is the case with many institutional settings, schools are complex contexts encompassing multiple subnetworks (for example between teachers and parents, parents of different children, or even between parents and their children). Relations in all of these subnetworks are theoretically important to child outcomes, and all part of the social capital of the school. But educational studies of social capital generally focus on one of these subnetworks, often measured with a single survey item, rather than integrating them and examining the social capital in the school as a whole (Bryk and Schneider 2002; Carbonaro 1998; Coleman 1990a, b; Offer and Schneider 2007). School communities also have a nested structure, meaning that several smaller groups, of classrooms, make up the larger network.

In this paper, we examine how best to aggregate data on multiple relationships and relational characteristics within schools. We develop and validate a theoretically consistent measure of social capital that incorporates the characteristics of multiple subnetworks as well as the nested structure of a school community. Though we focus on the school context, we believe this approach is applicable to other complex institutional settings, especially those with a hierarchical or nested structure and members with different relational roles.

In the analysis that follows, we present evidence that supports the adoption of a measure of social capital that captures the dimensions of social capital often defined in the education literature (trust, shared expectations, and intergenerational closure) and the relations between all adults in the school network (parents, teachers, and school staff). Our analysis supports operationalizing social capital as the shared variance between items measuring different relational characteristics among different network members.

Our discussion proceeds in five parts. First, we review existing approaches to the measurement of social capital. Second, we present an alternative measurement strategy in which we take advantage of the common variance in individual parent survey items designed to assess multiple social relations and measure the social capital of a school. Third, we use data from two separate cohorts of a large-scale study of social capital in schools to evaluate this new measure's construct validity, or the degree to which the survey instruments measure a single, underlying construct. Fourth, we evaluate the measure's predictive validity, or the degree to which it predicts exogenous outcomes in theoretically consistent ways. Finally, we present a set of recommendations to education researchers and other scholars interested in social capital and discuss ways in which the measure we offer might be adapted to meet the needs of specific studies.

1.1 Social Capital and Its Measurement

1.1.1 Competing Conceptualizations

All measures of social capital are designed to capture some aspect of social relations but specific conceptualizations and operationalizations vary considerably. In the education literature, social capital is often defined as a network-level resource made up of a combination of trust, shared expectations, and, in schools or where children are concerned, intergenerational closure (Bronfenbrenner 2002). Rather than enter theoretical debates about the theoretical importance of such relational characteristics, we rely on this widely used conceptualization to develop and validate an empirical approach that integrates relational characteristics across multiple subnetworks. There are two other influential schools

of thought, one that defines social capital by its function and one that treats social capital as an individual resource. We will discuss these varying theoretical approaches briefly. But we also argue that our main contribution—accounting for network structure within institutional settings when measuring social capital—can be applied across conceptions of social capital.

First, we depart somewhat from scholars who follow Coleman (1990a, b), defining social capital by its function. For Coleman social capital is "a variety of different entities having two characteristics in common: they all consist of some aspect of social structure and they all facilitate certain actions of individuals who are within the structure" (Coleman 1990a, b, p. 302). Researchers from the Coleman school of thought measure social capital with instruments capturing community participation and engagement, such as youth participation in extracurricular activities (White and Gager 2007) or beyond the education literature, measures such as civic associational membership (Putnam 2000). While participation and membership are useful proxies, they are also endogenous to social capital and therefore problematic in the sense that while participation is likely to engender social capital, individuals with greater access to social capital are also more likely to participate in activities for a variety of reasons. Because we intend our measure to be used in causal studies, we focus on relationships rather than participation or membership. We present a measurement strategy that captures relational characteristics, rather than consequences of social capital. However, the lessons we learn from this analysis about accounting for network structure could also be applied in studies that measure social capital with membership- or participation-based instruments.

The other way in which our conceptualization of social capital differs from that of other notable scholarship is that our conception is collective; we focus on the characteristics of social relations within a network, and treat social capital as a property of the community. In this way, we differ from individual-based conceptualizations (e.g. Lin and Erickson 2008). Scholars who take the individual approach view social capital as the resources an individual can access through social ties (see also Flap 2004; Erickson 1996; Lin 2001). Such conceptualizations of social capital focus on an individual's personal network, rather than the social capital of an institutional group or community, like a school. Approaches to measurement often rely on position or name generators in which a subject is prompted to describe his or her personal network. One advantage of this approach is that measurement is precise and consistent across studies. In contrast, studies of the collective conceptualization of social capital focus on different relational characteristics and different relationships within schools. Similarly, our treatment differs from Portes (1998) and other scholars who focus on relational characteristics like trust, but still see social capital as an individual property, manifest as an individual's psychological feeling of general connectedness and trust towards others (e.g. Horvat et al. 2003; Johnston and Soroka 2001).

Instead, we follow scholars like Sampson et al. (1999) treating social capital as a collective property that operates for children through personal and organizational networks (see also Gamoran et al. 2012). Trust and shared expectations are reciprocated and transformed from individual feelings to a community resource when parents are part of a network in which they know one another and expect norms to be enforced.

Our aim is to offer a strategy for valid, reliable measurement of collective social capital within school communities. To that end, we examine how best to aggregate data on different characteristics or relationships within a school, taking the network structure into account.

1.1.2 The Dimensions of Social Capital

Though it is not our primary purpose, our method has the added benefit of allowing scholars to examine and compare the contributions of various relational characteristics. We integrate questionnaire items on trust, closure, and norms of reciprocity. Many other studies focus on these dimensions of social capital, but most research on social capital and education works with a single dimension, often captured by a single survey item. Bryk and Schneider (2002) measure the trust that exists among relationships in a specific network, finding that increased trust promotes child development via greater potential for sharing both information and norms. Tsuzuki (2005) develops the validity of the trust dimension further by asserting that members of a network characterized by high levels of trust are more likely to rely on one another and to engage in actions that rely on the actions of others.

Another single-dimension measure of social capital that appears in the education literature is intergenerational closure, occurring when parents form relationships with the parents of their children's friends (Carbonaro 1998; Coleman 1988, 1990a, b). To the extent that a network has high intergenerational closure, it is more likely that norms will be shared and shared expectations enforced (Morgan and Sorensen 1999). Offer and Schneider (2007) found that children play a mediating role in generating social capital in that children's connections with one another mediate the development of intergenerational closure; their connections enable their parents to meet. It is less common in the education literature to find measures of shared expectations, which are also an important theoretical dimension of collective social capital (Coleman 1988; Kao 2004).

1.1.3 A Latent Construct Approach

Support for measuring social capital with single items or dimensions is rooted in an argument for focusing on network mechanisms that might facilitate the formation of social capital, instead of "metaphors" of social capital that are loosely tied to "distant empirical indicators" (Burt 1997, 2000). Given that one of the few points of agreement in the measurement of social capital is that the overarching social structure is a form of capital that connects individuals to opportunities to better meet their needs and goals, Burt calls for a stronger analysis on the specific mechanism of the connectedness (Burt 2000). We support this effort to examine multiple relational characteristics, but also see a need for the disparate relational characteristics in the literature to be put into dialogue with one another. In this way, we agree with Morrow (1999) who supports Burt's framework, but with one caveat. Morrow argues that we should focus on a set of several processes or characteristics that contribute to the formation of one, more holistic measure of social capital. Such characteristics include the features of social life—networks, norms, and trust—that enable individuals to more effectively pursue both their individual and shared goals (Putnam 1995). Similarly, Woolcock (1998) proposes the measurement of multiple dimensions of social capital. The framework we propose is flexible in that it allows scholars to assess the relative contributions of different dimensions as well as the shared variance between them using a latent construct approach.

A few others outside of the education literature have used a latent construct approach to combine and capture the shared variance between the components of social capital. Paxton (1999) measures social capital based on a latent construct of the strength of community engagement to argue against the general decline in social capital thesis. Kay and Wallace

([2009](#)) also put forth a latent construct for measuring social capital in terms of mentoring relationships.[1]

As this literature makes clear, there are theoretical and scientific advantages to both approaches, examining each component separately, and measuring a latent trait that captures the shared variance between them. We ask whether scholars can do both, by using a survey battery that captures multiple components of social capital, and constructing a single measure from the battery.

However, no matter which facets of social capital scholars see as most important, the structure of complex institutional settings, like schools, is likely to be an important consideration when aggregating data. All of the measures we have discussed, whether they involve single or multiple dimensions of social capital, focus on the relationships in single subnetworks within institutional settings or communities. In complex institutional contexts, like schools, such a restriction is problematic. For example, studies may focus on the relationships between families and school personnel, between different families, or even between parents and children. All of these subnetworks are important, and together they hold the social capital of the school community, which might influence the development of the children in it. To our knowledge, we are the first to systematically account for multiple relevant subnetworks as well as the nested structure of a school in a latent construct measure. In the next section, we discuss how we build this measure, using unique survey data from parents in elementary schools.

2 Data and Method

A theoretically guided measure of social capital within schools should capture relational characteristics within multiple subnetworks—parent–parent, parent–teacher, and parent–staff. Here we integrate trust, shared expectations, and intergenerational closure, following much of the literature in education, but the empirical approach we propose could be applied to other relational characteristics. We develop and test our measurement model drawing on survey data from two successive cohorts (2008–2009 and 2009–2010) of first graders and their families participating in an experimental study of the effect of social capital on child and family outcomes.[2] The 5-year Children, Families and Schools Project tested the effects of Families and Schools Together (FAST), an after-school program designed to build relationships of trust between parents and parents and school personnel. Fifty-two schools (26 in San Antonio, Texas and 26 in Phoenix, Arizona) with high concentrations of low-income and Hispanic families volunteered to participate in the study and agreed to randomization. Families of children in schools randomized to the treatment participated in FAST while those assigned to the control group carried out business as usual (Gamoran et al. [2012](#)).

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[1] Another way social capital scholars have moved beyond the single-item approach is by employing name or position generators (Van Der Gaag and Snijders [2004](#), [2005](#)). These generators have many advantages; however, they focus attention on the individual and do not account for different subnetworks within complex settings. Position generators, which rely on occupational prestige, can be less useful in studies of schools or other institutional settings in which the occupations of many members are a relative constant (i.e. teachers), and members like parents may not know one another's occupations.

[2] Participants were administered written surveys in their native language. Parents completed pre-treatment surveys in person at the time of consent. The follow-up questionnaires were distributed by mail. Non-respondents after repeated reminders were surveyed over the phone. The response rate was 70 % for post-treatment parent surveys.

Table 1 lists the survey items used in our analysis. The parent surveys that generate our data ask about many characteristics of parent–parent, parent–teacher, and parent–staff relationships. We arrange survey items so that each corresponds with one of three sub-networks: relations between parents and other parents, between the classroom teacher and parents, and between the school staff members in general and parents, and three theoretically determined dimensions: trust, shared expectations, and intergenerational closure. Table 1 lists the survey items and categorizes them according to the subnetwork and dimension of social capital each item is designed to measure. For example, survey question 8a asks parents how much other parents in the school help them with tasks such as babysitting. This question is designed to measure trust between parents. Question 5e asks parents whether they believe the classroom teacher tells them the truth about their child.

Table 1 Questions used in models of social capital

Question	Subnetwork	Dimension
Q8a) How much do other parents at this school help you with babysitting, shopping, etc.?	Parent–parent	Trust
Q9a) How much do you help other parents at this school with babysitting, shopping, etc.?		
Q8b) How much do other parents at this school listen to you about your problems?		
Q9b) How much do you listen to other parents at this school about their problems?		
Q8c) How much do other parents at this school invite you to social activities such as meals and parties?	Parent–parent	Trust and intergenerational closure
Q9c) How much do you invite other parents at this school to social activities such as meals and parties?		
Q10) How much do other parents at this school share your expectations?	Parent–parent	Shared expectations
Q11) How many parents of your child's friends at this school do you know?	Parent–parent	Intergenerational closure
Q5a) This teacher treats me with respect.	Parent–teacher	Trust and shared expectations
Q5b) I feel comfortable talking to this teacher.		
Q5c) The teacher and I get along.		
Q5d) The teacher is fair to my child.		
Q5e) The teacher tells me the truth about my child.		
Q5f) I feel the teacher and I are partners.		
Q5g) This is a good teacher.		
Q5h) The teacher wants my child to do well in school.		
Q6a) How much do you trust the school staff to do what is best for your child?	Parent–staff	Trust
Q6b) How much do you feel respected by staff at this school?		
Q6c) How much do you feel that the school staff works to build trusting relationships with parents?		
Q7) How many of the school staff would you feel comfortable approaching if you had a question about your child?		
Q6d) How much does the school staff share your expectations for your child?	Parent–staff	Shared expectations

This item measures trust, but between the parent and teacher. Some items could be interpreted as tapping into multiple aspects of social capital (e.g. item 9c, which asks about social interaction with other parents could capture trust and intergenerational closure). We acknowledge this fact, and in the results that follow, we assess the degree to which such items load with the dimensions we propose.

A theoretically preferable measure of the social capital in a child's school network would capture relationships between different important adults. But whether it is empirically advisable to combine dimensions and relationships into a single measure, and how best to do that, are open questions. To address them we use data from the first year cohort of study participants and build a measurement model using factor analytic techniques. We examine whether each subnetwork and each dimension ought to be measured together or separately. We then test the resulting model with data from participants in our second year cohort.

Any measurement model requires that we impose structure on our data. Aggregate scales, used by many of our predecessors, may be adequate in many methodological endeavors. But our measurement target makes factor analysis a more attractive approach. If we were to aggregate responses, we might blindly combine concepts that turn out to be weakly related to one another. Factor analysis provides valuable clues about our conceptualization and measurement in cases where the data do not conform to expectations. Also, the items in this battery have different response scales; aggregating seven-point scales with four-point scales may be misleading or rest on assumptions about the data that are unwarranted. The particular factor analytic method we use tackles questions with different numbers of categories by placing them on a common metric.[3]

We examine whether the data are empirically consistent with our theoretical model by testing (a) whether the data are better reduced when we separate various subnetworks, (b) whether it is statistically meaningful to control for the influence of teacher or classroom clustering, (c) whether the data are better reduced by separating various dimensions of social capital, (d) whether the construct validity of the resulting model is robust to estimation with data from a separate cohort of study participants, and (e) whether our resulting measure reliably predicts other outcomes in a way that is consistent with theory and prior research about social capital.

2.1 The Measurement Model and Construct Validity

To assess whether a single, valid, and reliable measure of social capital can be extracted from a theoretically comprehensive set of parent survey items, we proceed through a series of models. We begin with a simple, single-factor model, Model 1, in which all items are forced to load onto a single underlying construct. We then progressively account for properties of the school network: classroom clustering, subnetworks, and dimensions of social capital. Each model is estimated with data from two separate cohorts of study participants, which underscores the reliability of our results.

We use our naïve single-factor model (Model 1) as a reference for comparison with the other models that explicitly incorporate the network structure. Table 2 displays the fit statistics for models specified to take network structure into account. The first three rows of the table contain Model 1 fit statistics for cohort 1 data, cohort 2 data, and both cohorts combined. We report three fit statistics: the Comparitive Fit Index (CFI), the Tucker Lewis

Table 2 Subnetwork models: comparisons of model fit using TLI (Tucker Lewis Index), CFI (Comparative Fit Index), and RMSEA (Root Mean Square Error of Approximation)

Model	Cohort	CFI	TLI	RMSEA
Model 1—naïve single-factor model	1	0.893	0.793	0.211
	2	0.838	0.82	0.201
	Combined	0.829	0.81	0.205
Model 2—Model 1 + "within" classroom	1	0.822	0.814	0.111
	2	0.848	0.842	0.106
	Combined	0.838	0.832	0.11
Model 3—factor of factors (subnetworks separated)	1	0.984	0.981	0.063
	2	0.988	0.986	0.056
	Combined	0.986	0.984	0.059
Model 4—Model 3 + "within" classroom	1	0.991	0.99	0.027
	2	0.994	0.994	0.023
	Combined	0.992	0.991	0.027

Index (TLI), which show how much of the covariance matrix is accounted for by the model, and the Root Mean Square Error of Approximation (RMSEA), which captures the difference between the observed and predicted covariances for each model. Ideally, the CFI and TLI will be above 0.95 in a good fitting model, and the RMSEA will be below 0.05. It is important to assess the fit of factor analytic models with several fit statistics to avoid "cherry picking" desirable results. All of the findings discussed below are robust across all three fit statistics.

The fit for the naïve single-factor model (Model 1) is weak no matter the data used to estimate it. None of the fit statistics meets conventional standards in any cohort. Therefore, we find it unadvisable to simply combine all of our items with a single factor. This naïve model does not take the complex network structure of a school into account. So we begin by examining whether doing so improves the fit of the measurement model.

Model 2 accounts for the nested classroom structure of schools. Children and their families are clustered into classrooms with their own teachers. The teacher is therefore a centerpiece in classroom social network, but the nature and quality of social ties may vary in ways that may analytically overemphasize teacher's role. That is, between classrooms the quality and activity of the teacher, or a few parents, will influence a classroom's overall level of trust, shared expectations, and intergenerational closure in a way that is not representative of overall community (school) norms.[4] Accounting for the hierarchical structure of school data has, as Konstantopoulos and Borman explain, "in several respects, brought about a revolution in the analysis of school effects." (2011, 104). However, this insight has not been extended to the measurement of social capital. In Model 2, we hold variance between teachers (classrooms) constant, where social capital is measured as if a teacher (classroom) with identical attributes were constructed for each parent, holding

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[4] Whether or not teacher/classroom clustering is modeled when measuring social capital is also a theoretical question that must be answered based on the goals of an individual study. Because our aim is to capture whole-school social capital, variation *between* classrooms, which depends heavily on the quality and practices of the teachers themselves, is not of interest. However, if an investigator is interested in teacher effects, rather than school effects, the between-teacher variation would be essential. Therefore, researchers interested in teacher effects should not take steps to focus on within classroom variation, as we do in Models 2 and 4.

classroom characteristics constant. Model 2 is a minor improvement upon Model 1; the CFI and TLI both increase and the RMSEA decreases, but not enough to meet conventional standards of model fit.

But nesting of individuals within classrooms is not the only important aspect of a school's network structure. As we have discussed, members of the network can also be organized into separate subnetworks. We model that structural element in Model 3, in which we account for the three subnetworks in the community—between parents and the classroom teacher, parents and staff, and parents and other parents. Naïvely combining all of the items is not advisable. But can a single measure be reliably extracted from items characterizing the subnetworks? In Model 3, separate factors (Parent–Staff, Parent–Teacher, and Parent–Parent) are estimated and allowed to associate with one another, producing a single, global "factor of factors" score, a measure of the overall social capital in the school.

Model 3 shows remarkable improvement over the naïve single-factor model fit. The CFI and TLI are both excellent across data cohorts, and the RMSEA is reduced enough to indicate reasonable approximate model fit. In a school, this empirical conclusion has important theoretical meaning—though we may want to think about the school as a single community, the relations between various community members do not follow a common structure. Across the schools in this study, the relationships between parents do not map as well with the relationships between parents and school personnel. A school is a complex institutional setting, and it appears that modeling the network structure is paramount to extracting a measure of social capital.

Next, in Model 4, we reintroduce the nested structure of the data, and examine whether a model that accounts for both nesting within classrooms and the three subnetworks is an improvement. Indeed it is. Model 4 provides a superior description of the data. By any of the three fit statistics we examine, the model fit is excellent. Across cohorts, all fit statistics show that this model best reduces our data. Educational researchers across disciplines have turned to hierarchical modeling to appropriately account for the structure of school communities, and here we show that measurement models in schools can be improved by doing the same, accounting for the nested structure and the various subnetworks within the school.

We are primarily interested in the results in Table 2, the extent to which modeling network structure can improve the fit of a social capital measurement model. However, we recognize that readers may be interested in whether it is empirically appropriate to combine the dimensions of social capital (trust, shared expectations, and intergenerational closure). The results presented in Table 2 show that accounting for network structure is important. We see the decision about whether to combine or separate dimensions as primarily theoretical in nature. As we explained in the introductory sections of the paper, conceptualizations of social capital vary widely. Some researchers may find it theoretically preferable to combine dimensions of social capital and to conceptualize social capital as their shared variance, and others may find it preferable to examine dimensions like trust and closure individually, given the goals of their research.

So, though we remain agnostic about whether it is theoretically desirable to combine multiple facets of social cohesion, for scholars whose theoretical approach demands a single, latent social capital construct, we examine whether individual facets of social capital do, in fact, load together. Additionally, from an empirical standpoint, aggregating survey items can eliminate a great deal of measurement error, often revealing a latent trait with superior explanatory power.

Table 3 Dimension models: comparisons of model fit using TLI (Tucker Lewis Index), CFI (Comparative Fit Index), and RMSEA (Root Mean Square Error of Approximation)

Model	Cohort	CFI	TLI	RMSEA
Model 1—Naïve single-factor model	1	0.893	0.793	0.211
	2	0.838	0.82	0.201
	Combined	0.829	0.81	0.205
Model 5—factor of factors (dimensions separated)	1	0.831	0.811	0.202
	2	0.864	0.848	0.185
	Combined	0.85	0.832	0.192
Model 6—Model 5, 8c and 9c allowed to load on IGC	1	0.839	0.817	0.198
	2	0.872	0.854	0.181
	Combined	0.858	0.838	0.189
Model 7—Model 6 + "within" classroom	1	0.901	0.894	0.089
	2	0.925	0.92	0.08
	Combined	0.912	0.906	0.806

Table 3 presents the results from a progression of factor analytic models accounting for the dimensionality of social capital in our survey battery. We again report Model 1, the naïve single-factor model as a benchmark against which to evaluate the other models. Model 5 separates trust, intergenerational closure, and shared expectations, with very little improvement to any fit statistics over Model 1. Model 6 does the same, though we allow two items, 8c and 9c, which we discussed earlier as capturing both trust and closure, to load onto both dimensions. Taking this step offers a minor improvement [constrain improvement on Model 5: χ-sq (81.4, 3df)], but the improvement is insufficient to accept the measurement model. Model 7 shows the results of a model separating the dimensions and accounting for the hierarchical (nested) structure of the data. As with the other models in Table 3, no fit statistic reaches conventional thresholds for goodness of fit.

Overall, the results presented in Table 3 show that the dimensions do load together well, and they are related to a single, underlying construct. Modeling the dimensions of social capital separately provides very minor improvements to fit (as compared with the naïve single-factor model). The empirical results match the prevailing collective theory in this case—social capital can be treated as the overall social cohesion of the community, and items measuring all three dimensions: trust, shared expectations, and intergenerational closure—are important, valid indicators of the underlying social capital in the school. Therefore, depending on the theoretical goals of the study, researchers can examine dimensions like trust individually, or assess the contributions of a single latent social capital trait. Both strategies are empirically appropriate, but a "factor of factors" approach is unnecessary when it comes to the dimensions of social capital. Again, the results are reliable across cohorts.[5]

Table 4 displays the factor loadings for all items for Model 4, the model with the superior fit which accounts for the subnetworks and nested structure of the data. Here, we validate our results using a split sample approach; our two cohorts are independently

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[5] We have an insufficient number of questionnaire items to estimate a nine-factor model in which sub-networks and dimensions are separated. We highlight this as an avenue for future research. However, we reiterate that the analyses reported here show clearly that modeling the dimensions of social capital separately provides trivial improvements in fit.

Table 4 Model 4 estimated with data from separate cohorts

	Cohort 1	Cohort 2 (constrained)	Cohort 2 (unconstrained)	Combined
Parent–parent				
Q8a	1.32	←	1.51	1.38
Q8b	1.823	←	1.894	1.88
Q8c	1.691	←	1.665	1.667
Q9a	1.416	←	1.491	1.442
Q9b	1.839	←	1.685	1.796
Q9c	1.66	←	1.621	1.662
Q10	0.994	←	0.865	0.89
Q11	1.018	←	0.992	0.698
Parent–teacher				
Q5a	2.506	←	2.255	2.279
Q5b	2.688	←	2.475	2.478
Q5c	1.986	←	2.215	2.093
Q5d	2.378	←	2.5	2.448
Q5e	2.366	←	2.646	2.473
Q5f	1.291	←	1.518	1.421
Q5g	3.076	←	3.382	3.262
Q5h	2.565	←	2.586	2.527
Parent–staff				
Q6a	1.586	←	1.843	1.754
Q6b	1.87	←	1.997	1.981
Q6c	2.378	←	2.042	2.16
Q6d	1.9	←	1.547	1.663
Q7	0.881	←	0.916	0.781
PP ↔ PT	0.143	←	0.158	0.155
PS ↔ PT	0.436	←	0.547	0.494
PS ↔ PP	0.238	←	0.266	0.245
RMSEA	0.022	0.024	0.021	0.023
CFI	0.994	0.993	0.994	0.994
TLI	0.994	0.993	0.995	0.993

sampled and unrelated. The model is first estimated with data from Cohort 1. We then conduct a confirmatory factor analysis using data from Cohort 2, in which loadings are constrained to those from the Cohort 1 level. Third, we conduct a second exploratory factor analysis with data from Cohort 2, and finally, we estimate a model with the combined data. The results for all specifications are remarkably similar. As with previous models, our conclusions hold whether we look at Cohort 1, Cohort 2, or the combined sample. Because these two cohorts are separate random draws from the population, Table 4 demonstrates that our results are consistent beyond the original data on which the models were estimated.

By examining the fit of the models in Tables 2, 3 and 4, we show that the model accounting for subnetworks and clustering is superior. These results should encourage researchers to model the structure of the social networks within complex institutional

settings like schools, accounting for any subnetworks and clustering that may exist. In an elementary school, this means modeling relations between network members with different roles (parents, teachers, and staff) as well as the nested classroom structure of the data.

We offer this result with one caveat. It is important to note the three subnetworks' correlations are not uniform. Making the leap to a common concept requires that we accept the weights each subnetwork gives to an overall measure of social capital. In our case, this means assigning more influence to the parent–teacher and parent–staff questions. Therefore, though it is empirically possible to extract a grand measure of social capital that fits the data well, researchers should consider also examining the behavior of each subnetwork factor separately to avoid overemphasizing the influence of parent–teacher and parent–staff relationships.

2.2 Predictive Validity

We conclude with simple tests of predictive validity. Here we examine whether our measures of social capital relate to other constructs in theoretically consistent ways. We evaluate the strength of the measures examined in the previous section by assessing the relationship between the social capital measures and variables that are not included in the measure but have a known association with social capital: child behavior and adult mental health, regressing each variable on the measures of social capital we have discussed.

If our measures of social capital correctly predict improvements in parental depression and student behavior, we see them as having strong predictive validity. We note here that we are not testing whether social capital in the school community *causes* child behavioral or parental mental health outcomes. Rather, given that previous research asserts that social capital is correlated with both of these outcomes, we look to see whether our proposed measures behave in expected ways.

We first assess the predictive validity of our measures of social capital using two indicators of child behavior: teacher reported negative and positive behavior in the classroom for each student. Social capital in a school is theoretically correlated with the behavior of the children because stronger adult social relations situate the children in a context where behavioral norms are enforced, support and communication are stronger, and stressors are decreased. Previous empirical studies have demonstrated this association (e.g. Parcel and Dufur 2001; Gamoran et al. 2012). We measure both negative and positive behavior with items from the "Strengths and Difficulties Questionnaire" (SDQ) (Goodman 1997). Positive behavior is measured with an additive scale of the teacher-assessed positive behaviors from the SDQ, and negative behavior is measured with an additive index of the negative behaviors from the questionnaire.[6]

As an additional check of the robustness of our findings, we examine the association between our measures of social capital and parent mental health. Previous research suggests a negative association between social capital at the individual level and depression (De Silva et al. 2005, 2007). At the community level, social connections and social capital within neighborhoods are associated with improved mental health outcomes for residents (Ziersch et al. 2005). More and stronger social ties within a parent's community also reliably decrease levels of depression, and for parents of young children, the school can be an important center of social interaction and interpersonal relationships (e.g. Warren et al.

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[6] There are 25 items in the SDQ. Items ask the teacher to assess several negative and positive child characteristics such as "shares readily" and "often looses temper." The full battery is available in Goodman (1997).

2009), and thus the social capital that matters for mental health. Especially for parents who experience significant stressors, friendships with other parents can be an important protective mental health factor (Thompson and Ensminger 1989). It stands to reason, given the importance of social interaction to mental health and the higher levels of social support and information sharing about resources within high social capital communities, that parents in school communities with high social capital will be less vulnerable to depression.[7]

We conduct this test with twelve candidate measures: factor scores extracted from each of the models presented in the previous construct validity section, and separate factors for each of the three subnetworks (parent–parent, parent–teacher, and parent–staff) and each of the three dimensions (trust, shared expectations, and intergenerational closure).[8] We begin with separate measures of the subnetwork social capital (parent–parent, parent–staff, and parent–teacher). Table 5 presents the coefficients from a series of models in which we regress the dependent variables (positive behavior, negative behavior, and parent depression) on the models accounting for the network structure. Figure 1 displays the results visually. Each separate subnetwork measure is associated with the outcomes in the expected direction, and all coefficients reach conventional levels of statistical significance.

We then proceed to examine three measures of the overall social capital in the school community: the naïve factor for comparison sake, which simply combines all items (Model 1), the naïve model that accounts for the hierarchical data structure (Model 2), the global "factor of factors" measure which combines the three subnetwork factors (Model 3), and the global "factor of factors" measure which also accounts for the nested structure of the data (Model 4). The coefficients are signed as expected and all significant, indicating that the more complex measures that account for network structure are also strong predictors of student behavior and parent depression.

This regression-based method has a second advantage, in that it allows for the comparison of the relative contributions of each subnetwork, thus providing a method for being precise about which relationships are most important to the outcomes in question. For example, the hierarchical global factor that captures the social capital within classrooms is the weakest predictor of student behavioral outcomes, though the coefficients are still signed in the expected direction and achieve statistical significance. That result indicates that the relational characteristics that matter most for an individual student's behavior likely vary a great deal between classrooms and teachers. Here, we see that washing out the between classroom variation that is driven by teachers generates a weaker predictor of student behavior.

We turn next to an examination of the predictive validity of the measures that take into account the multidimensional nature of social capital. Though, as we discussed in the previous section and showed in Table 3, separating the dimensions does not produce large improvements in model fit, researchers may have theoretical interest in examining trust, shared, expectations, and intergenerational closure separately. Table 6 and Fig. 2 present the results of a series of models in which we regress the outcomes of interest (behavior and depression) on candidate items that account for the dimensionality of social capital. Again, all separate dimension factors (trust, shared expectations, and intergenerational closure) are

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[7] The parent depression variable is created from an additive index of responses to the following: "over the last 2 weeks, how often have you experienced the following? Little interest or pleasure in doing things (Never, Several Days, Most Days, Every Day); feeling down depressed or hopeless (Never, Several Days, Most Days, Every Day).

[8] Model 5 from Table 3 is excluded from this analysis, because we found that the fit of Model 6 (where items 8c and 9c were allowed to load onto intergenerational closure) was superior.

Table 5 Predictive validity of modeled factors: subnetworks of social capital in schools

Dependent variable	Independent variable	Coefficient	Standard error
Parent depression	Parent parent subnetwork	−0.3353**	0.0428
Parent depression	Parent teacher subnetwork	−0.2467**	0.0318
Parent depression	Parent Staff Subnetwork	−0.2362**	0.0328
Parent depression	(Model 1) naive single-factor model	−0.3492**	0.0621
Parent depression	(Model 2) naive single-factor model (within classroom)	−0.3453**	0.0488
Parent depression	(Model 3) global factor	−0.3621**	0.0639
Parent depression	(Model 4) global factor (within classroom)	−0.4425**	0.0521
Positive behavior	Parent parent subnetwork	0.8923**	0.1172
Positive behavior	Parent teacher subnetwork	0.5317**	0.1209
Positive behavior	Parent staff subnetwork	0.5295**	0.1192
Positive behavior	(Model 1) naive single-factor model	0.9305**	0.1246
Positive behavior	(Model 2) naive single-factor model (within classroom)	0.6107**	0.1017
Positive behavior	(Model 3) global factor	0.6745**	0.1345
Positive behavior	(Model 4) global factor (within classroom)	0.2109*	0.1164
Negative behavior	Parent parent subnetwork	−0.7789**	0.1182
Negative behavior	Parent teacher subnetwork	−0.4973**	0.1219
Negative behavior	Parent staff subnetwork	−0.4142**	0.1201
Negative behavior	(Model 1) naive single-factor model	−0.8484**	0.1258
Negative behavior	(Model 2) naive single-factor model (within classroom)	−0.5510**	0.1057
Negative behavior	(Model 3) global factor	−0.6072**	0.1354
Negative behavior	(Model 4) global factor (within classroom)	−0.2086*	0.1221

Parent depression is an ordinal dependent variable and uses ordinal logistic regression (q12b) Positive behavior uses an additive scale of the teacher-assessed positive behaviors in the "Strengths and Difficulties Questionnaire" administered post-treatment (Goodman 1997). Negative behavior uses an additive scale of the teacher-assessed negative behaviors in the "Strengths and Difficulties Questionnaire" administered post-treatment

* Significant at 5 % level

** Significant at 10 % level

strong predictors of these outcomes. However, the predictive validity of the measures that aggregate the dimensions (Models 6 and 7) is less consistent. Both predict parental depression, but these models do not predict positive child behavior and only the "within classroom" global factor predicts negative behavior. We caution readers to remember that fit of the models that do not account for the network structure is also poor. We recommend that researchers focus on the dimensions of social capital separately, but proceed cautiously when aggregating factors extracted from these dimensions, acknowledging the possibility that a global "factor of factors" approach may not be appropriate if the network structure is not taken into account.

We have already established that the measures that account for the network structure have good theoretical and construct validity, and through the regressions we see that they also relate to other constructs in a theoretically consistent way. The two global factors, calculated with our Measurement Models 3 and 4 are good predictors of child behavior and adult mental health. In studies examining the impact of total social capital in a complex setting on such outcomes, this global measurement approach is researchers' best choice.
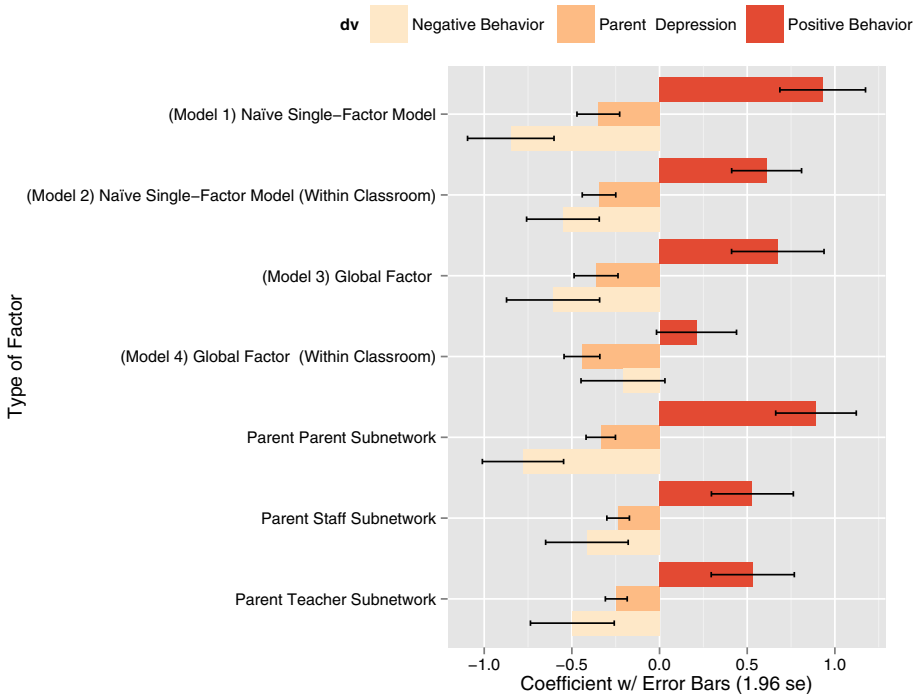
Fig. 1 Results from Table 5, validation variables on social capital

However, this analysis also shows that when scholars are interested in disentangling the contributions of various dimensions of social capital, and the social capital within different subnetworks, the contributing factors are also good predictors of theoretically important outcomes.[9] We reiterate though that whatever the goals of future social capital studies, and whichever relational traits are examined, empirically, the data are best reduced by a model that takes the structure of the networks into account.

3 Discussion

In sum, we suggest that education researchers and scholars who study other similarly complex institutional settings think carefully about the structure of the social network and include items that measure the relational characteristics of each subnetwork of members— here parents' relations with other parents, parents' relations with teachers, and parents' relations with school staff. The common variance in these subnetwork and dimension items can be exploited to create a theoretically and empirically valid measure of social capital within a school. Researchers can also take advantage of the advances in hierarchical

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[9] This is not the case for the individual survey items themselves, which are consistently weaker predictors. Latent traits generated from aggregating multiple measures tend to have stronger relationships with important outcomes as compared to single items due to reduced measurement error and the associated downward bias in the coefficients. The regression analysis provides evidence for that phenomenon.

Table 6 Predictive validity of modeled factors: dimensions of social capital in schools

Dependent variable	Independent variable	Coefficient	Standard error
Parent depression	Trust	−0.2406**	0.0528
Parent depression	Shared expectations	−0.2793**	0.0534
Parent depression	Closure (qlI, q8c, q9c)	−0.2941**	0.0530
Parent depression	(Model 1) naive single-factor model	−0.3492**	0.0621
Parent depression	(Model 2) naive single-factor model (within classroom)	−0.3453**	0.0488
Parent depression	(Model 6) global factor	−0.4916**	0.0321
Parent depression	(Model 7) global factor (within classroom)	−0.4375**	0.0393
Positive behavior	Trust	1.0141**	0.1297
Positive behavior	Shared expectations	0.6276**	0.1264
Positive behavior	Closure (qll, q8c, q9c)	0.9689**	0.1250
Positive behavior	(Model 1) naive single-factor model	0.9305**	0.1246
Positive behavior	(Model 2) naive single-factor model (within classroom)	0.6107**	0.1017
Positive behavior	(Model 6) global factor	−0.2127*	0.0683
Positive behavior	(Model 7) global factor (within classroom)	0.1189	0.0847
Negative behavior	Trust	−0.8842**	0.1310
Negative behavior	Shared expectations	−0.6207**	0.1271
Negative behavior	Closure (qll, q8c, q9c)	−0.8418**	0.1263
Negative behavior	(Model 1) naive single-factor model	−0.8484**	0.1258
Negative behavior	(Model 2) naive single-factor model (within classroom)	−0.5510**	0.1057
Negative behavior	(Model 6) global factor	0.0727	0.0829
Negative behavior	(Model 7) global factor (within classroom)	−0.2042**	0.0954

Parent depression is an ordinal dependent variable and uses ordinal logistic regression (q12b) Positive behavior uses an additive scale of the teacher-assessed positive behaviors in the "Strengths and Difficulties Questionnaire" administered post-treatment (Goodman 1997). Negative behavior uses an additive scale of the teacher-assessed negative behaviors in the "Strengths and Difficulties Questionnaire" administered post-treatment

* Significant at 5 % level

** Signficant at 10 % level

modeling to focus on the variation in social capital within classrooms, and further improve model fit, when the research question is not about between-teacher effects.

However, we caution that the relationships parents have with each other and the relationships they have with school personnel may be substantially independent. Researchers should examine the contribution of each subnetwork factor separately in their own data before proceeding to combine them. Though any approach should account for the structural subnetworks in some manner, the most robust approach to measurement may be the use of subscales that reflect the separate subnetworks rather than a single, global "factor of factors." There are also many substantive reasons scholars should examine social capital within subnetworks across schools. Perhaps one school has a particularly strong focus on teacher–parent communication, while another school may be in a neighborhood that suffers high residential mobility, making long-standing relationships between parents a logistical difficulty. Though these relationships all contribute to the social capital within the school, the best approach to aggregation may differ across studies. We recommend that researchers conduct independent tests of this phenomenon within other schools.
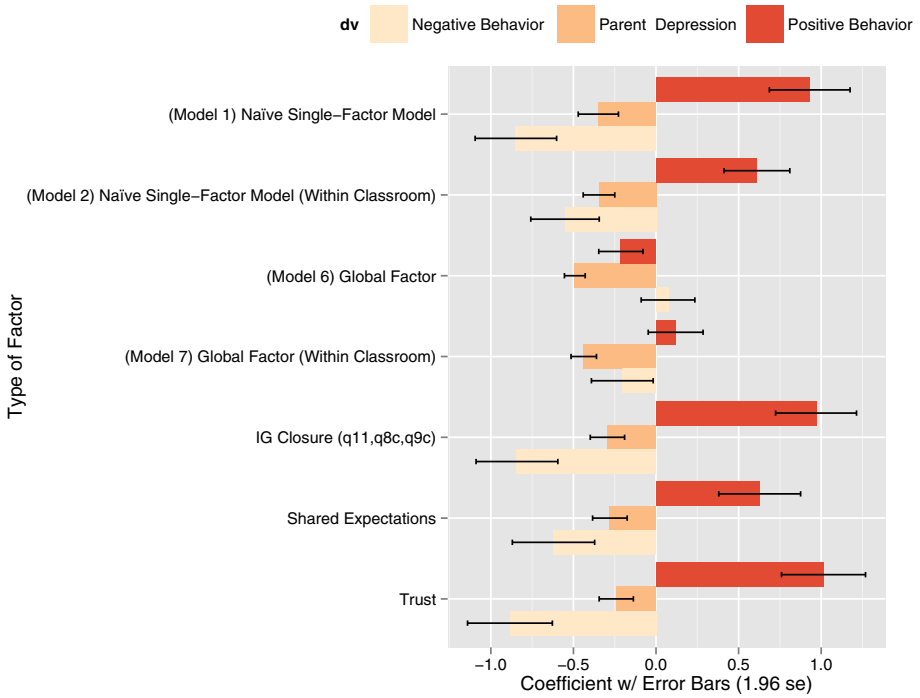
Fig. 2 Results from Table 6, validation variables on social capital

Researchers interested in other facets of social capital beyond trust, shared expectations, and closure can apply the general lessons from this analysis about accounting for sub-networks and clustering. And other education investigators, especially those studying schools serving older children and adolescents, may want to include additional subnetworks, measuring the qualities of different relations within the school, such as between parents and children, or among the children themselves. Here we have tested our measurement model with first grade children, parents, and teachers. The literature suggests that such young students should benefit from the social capital that exists among the adults in their school network, but studies of social capital at higher levels of schooling might sensibly take a different approach, incorporating the children's own relationships as well.

Scholars conducting research in the social sciences more broadly may also apply our technique, but may focus on other subnetworks within different institutional settings. For example, a study of social capital within a medical institution might examine the relationships between patients and their providers, among providers, between providers and administration, or among multiple patients.

Finally, the approach we have taken is clearly quantitative and important qualitative work is being done on social capital and education (e.g. Horvat et al. 2003). We have attempted to present our measurement approach in a way that can inform both bodies of research. Qualitative researchers can also incorporate multiple subnetworks of social capital in a measurement design. So, although our specific recommendations must be adapted to the needs of different studies, our main arguments remain: if researchers aim to uncover the importance of social capital in schools and other complex settings, the most

empirically valid approach to the measurement of social capital should include an attempt to model the structure of the specific network.

References

Bronfenbrenner, U. (2002). Preparing a world for the infant in the 21st century: The research challenge. In J. Gomes-Pedro, J. K. Nugent, J. G. Young, & T. B. Brazelton (Eds.), *The infant and family in the 21st century* (pp. 45–52). New York: Brunner-Routledge.

Bryk, A. S., & Schneider, B. L. (2002). *Trust in schools: A core resource for improvement*. New York: Russell Sage Foundation.

Burt, R. S. (1997). The contingent value of social capital. *Administrative Science Quarterly*, 339–365.

Burt, R. S. (2000). The network structure of social capital. *Research in Organizational Behavior, 22*, 345–423.

Carbonaro, W. J. (1998). A little help from my friend's parents: Intergenerational closure and educational outcomes. *Sociology of Education, 71*(4), 295–313.

Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology, 94*(Suppl.), S95–S120.

Coleman, J. S. (1990a). *Equality and achievement in education*. Boulder, CO: Westview Press.

Coleman, J. S. (1990b). *Foundations of social theory*. Cambridge: Harvard University Press.

De Silva, M. J., Huttly, S. R. A., Harpham, T., & Kenward, M. G. (2007). Social capital and mental health: A comparative analysis of four low income countries. *Social Science and Medicine, 64*, 5–20.

De Silva, M. J., McKenziee, K., Harpham, T., & Huttly, S. R. A. (2005). Social capital and mental illness: A systematic review. *Journal of Epidemiol Community Health, 59*, 619–627.

Erickson, B. H. (1996). Culture, class, and connections. *American Journal of Sociology, 102*, 217–251.

Flap, H. (2004). Creation and returns to social capital. In H. Flap & B. Volker (Eds.), *Creation and returns of Social Capital"* (pp. 3–24). London: Routledge.

Gamoran, A., Turley, R. N. L., Turner, A., & Fish, R. (2012). Differences between Hispanic and non-Hispanic families in social capital and child development: First-year findings from an experimental study. *Research in Social Stratification and Mobility, 30*, 97–112.

Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry, 38*, 581–586.

Horvat, E. M., Weininger, E. B., & Lareau, A. (2003). From social ties to social capital: Class differences in the relations between schools and parent networks. *American Educational Research Journal, 40*(2), 319–351.

Johnston, R., & Soroka, S. N. (2001). Social capital in a multicultural society: the case of Canada. In P. Dekker & E. M. Uslaner (Eds.), *Social capital and participation in everyday life* (pp. 30–44). London: Routledge.

Kao, G. (2004). Social capital and its relevance to minority and immigrant populations. *Sociology of Education, 77*, 172–175.

Kay, F. M., & Wallace, J. E. (2009). Mentors as social capital: Gender, mentors, and career rewards in law practice*. *Sociological Inquiry, 79*(4), 418–452.

Konstantopoulos, Spyros, & Borman, Geoffrey D. (2011). Family background and school effects on student achievement: A multilevel analysis of the Coleman data. *Teachers College Record, 113*(1), 97–132.

Lin, N. (2001). *Social capital: A theory of social structure and action*. Cambridge: Cambridge University Press. ISBN 978-0-521-52167-3.

Lin, N., & Erickson, B. (Eds.). (2008). *Social capital: An international research program*. Oxford: Oxford University Press.

Morgan, S. L., & Sorensen, A. B. (1999). Parental networks, social closure, and mathematics learning: A test of Coleman's social capital explanation of school effects. *American Sociological Review, 64*(5), 661–681.

Morrow, V. (1999). Conceptualising social capital in relation to the well-being of children and young people: A critical review. *Sociological Review, 47*(4), 744–765.

Offer, S., & Schneider, B. (2007). Children's role in generating social capital. *Social Forces, 85*(3), 1125–1142.

Parcel, T. L., & Dufur, M. J. (2001). Capital at home and at school: Effects on child social adjustment. *Journal of Marriage and Family, 63*(1), 32–47.

Paxton, P. (1999). Is social capital declining in the United States? A multiple indicator assessment 1. *American Journal of Sociology, 105*(1), 88–127.

Portes, A. (1998). Social capital: Its origins and applications in modern sociology. *Annual Review of Sociology, 24*, 1–24.

Putnam, R. D. (1995). Tuning in, tuning out—The strange disappearance of social capital in America. *Ps-Political Science & Politics, 28*(4), 664–683.

Putnam, R. (2000). *Bowling alone*. New York: Simon & Schuster.

Sampson, R. J., Morenoff, J. D., & Earls, F. (1999). Beyond social capital: Spatial dynamics of collective efficacy for children. *American Sociological Review, 64*(5), 633–660.

Thompson, M. S., & Ensminger, M. E. (1989). Psychological well-being among mothers with school age children: Evolving family structures. *Social Forces, 67*(3), 715–730.

Tsuzuki, K. (2005). Some conceptual problems of social capital: Tie, strength of tie and trust. *Sociological Theory and Methods, 20*(1), 81–95.

Van der Gaag, M. P. J., & Snijders, T. A. B. (2004). Proposals for the measurement of individual social capital. In H. Flap & B. Volker (Eds.), *Creation and returns of social capital* (pp. 199–218). London: Routledge.

Van Der Gaag, M., & Snijders, T. A. (2005). The Resource Generator: Social capital quantification with concrete items. *Social Networks, 27*(1), 1–29.

Warren, M., et al. (2009). Beyond the bake sale: A community-based relational approach to parent engagement in schools. *The Teachers College Record, 111*(9), 2209–2254.

White, A. M., & Gager, C. T. (2007). Idle hands and empty pockets? Youth involvement in extracurricular activities, social capital, and economic status. *Youth & Society, 39*, 75–111.

Woolcock, M. (1998). Social capital and economic development: Toward a theoretical synthesis and policy framework. *Theory and Society, 27*, 151–208.

Ziersch, Anna M., et al. (2005). Neighbourhood life and social capital: The implications for health. *Social Science and Medicine, 60*(1), 71–86.