Different Levels of Leadership for Learning: Investigating Differences Between Teachers Individually and Collectively using Multilevel Factor Analysis of the 2011-12 Schools and Staffing Survey

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ABSTRACT:

This study investigated the differences between how individual teachers perceive leadership for learning and how teachers collectively perceive leadership for learning, using a large nationally generalizable dataset of 7,070 schools from the National Center for Education Statistics 2011–12 Schools and Staffing Survey (SASS). This study used cross-validation multilevel factor analysis to find that individual teachers view leadership for learning as consisting of six factors (school influence, classroom control, collegial climate, student attendance, neighborhood context, teacher commitment) whereas teachers collectively (e.g., as a faculty) perceive three factors that are non-isomorphic with the individual-level factors (instructional leadership, management, social environment). These results imply that teachers collectively have a functional view of leadership, while individual teachers have views more aligned to specific areas of influence. This article provides the beginning of a theoretical framework for future multilevel educational leadership research into teacher leadership and leadership for learning.

Keywords: Leadership for Learning, School Leadership, Instructional Leadership, Teacher Perception, Multivariate Analysis, Factor Analysis, Factor Structure

INTRODUCTION:

The purpose of this study is to investigate the differences between how individual teachers perceive leadership for learning and how teachers collectively (i.e., as a faculty of a school) perceive leadership for learning, using a large nationally generalizable dataset, the Schools and Staffing Survey (SASS) from the National Center for Education Statistics (NCES). School leadership is important in supporting student achievement (Marzano, Waters, & McNulty, 2005), having the second largest positive effect on student growth, second only to teacher quality (Leithwood & Jantzi, 2008; Leithwood & Seashore-Louis, 2011).

One of the prevailing conceptual frameworks for understanding and measuring effective school leadership is instructional leadership theory (Hallinger & Murphy, 1985; Neumerski, 2013; Robinson, Lloyd, & Rowe, 2008). Instructional leadership theory maintains that principals should focus their efforts on defining the school mission, managing the instructional program, and creating a positive school climate (Hallinger & Murphy, 1985). Both principals and teachers take up important instructional leadership roles within schools (Leithwood, Mascall, & Strauss, 2009; Marks & Printy, 2003; Printy, Marks, & Bowers, 2009; Spillane, Halverson, & Diamond, 2001, 2004) with 'teachers [assuming] more leadership functions at both instructional and organizational levels of practice' (York-Barr & Duke, 2004, p. 255), suggesting that examining school leadership behaviours beyond the principal-based instructional leadership framework (Hallinger & Murphy, 1985) would provide a more comprehensive understanding of the practice of school leadership. Crucially, teachers often serve as the connection between leadership practices in schools and student achievement (Heck & Hallinger, 2009, 2014; Krüger & Scheerens, 2012; Price, 2015; Price & Moolenaar, 2015).

Recently, educational leadership researchers have extended the concept of instructional leadership into a broader framework of 'leadership for learning' – school leadership focused on the instructional aspects of schools, combined with managing the multiple and varied aspects of school administration to ensure school-wide alignment of all aspects of a school with instructional-centered leadership at its core (Boyce & Bowers, in press; Halverson, Kelley & Shaw, 2014; Hallinger, 2011; Knapp, Copland, and Talbert, 2003; Murphy, Elliott, Goldring, & Porter, 2006, 2007; Robinson, 2011). Several different leadership for learning frameworks have emerged within the field of educational leadership (Boyce & Bowers, in press; Halverson, Kelley & Shaw, 2014; Hallinger, 2011; Murphy, Elliott, Goldring, & Porter, 2006, 2007; Robinson, 2011). The

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specific definition of leadership for learning used within this study is defined as the collection of: vision for learning, instructional program, curricular program, assessment program, communities of learning, resource allocation and use, organizational culture, and social advocacy (Murphy, Elliott, Goldring, & Porter, 2006, 2007).

The combination of the emerging leadership for learning conceptual framework, the recognition that both teachers and principals have active leadership roles within schools, and the call for measuring leadership practices have led to the creation of instruments such as the Vanderbilt Assessment of Leadership in Education (VAL-ED) (Goff, Goldring, & Bickman, 2014; Porter, Polikoff, Goldring, Murphy, Elliott, & May, 2010) and Comprehensive Assessment of Leadership for Learning (CALL) (Halverson & Dikkers, 2011; Halverson, Kelly & Shaw, 2014; Kelley & Halverson, 2012). Both of these instruments measure leadership practices across multiple levels, including teachers and principals (Bowers, Blitz, Modest, Salisbury, & Halverson, 2017; Goff et al., 2014; Halverson & Dikkers, 2011; Kelley & Halverson, 2012; Porter et al., 2010). This work motivates the need for teacher perspectives to be taken into account in understanding the practice of leadership within schools for both theoretical reasons (Halverson & Dikkers, 2011; Knapp et al., 2003; Marks & Printy, 2003; Murphy et al., 2006; Spillane, Halverson, & Diamond, 2004) and methodological reasons (Hallinger & Heck, 2011; Heck & Hallinger, 2009, 2010).

In the present study, we use the recent 2011–12 administration of the Schools and Staffing Survey (SASS), a large nationally representative USA teacher survey, to examine how leadership for learning is perceived of in schools by teachers across two organizational levels: the individual teacher level and the collective teacher level. We employ the recent approach of combining cross-validation with multilevel factor analysis to address the past methodological issue of over-fitting exploratory factor models to the data, making generalizations to larger populations of interest problematic. Our findings include individual teachers perceiving of six factors of leadership for learning, teachers collectively perceiving of three factors of leadership for learning, and the factor structures of the two levels being non-isomorphic with each other.

LITERATURE REVIEW:

The traditional view of instructional leadership in schools was that principals were the sole instructional leaders of schools and that the sole responsibility of instructional leadership fell upon their shoulders (Hallinger & Murphy, 1985). Over the past fifteen years, new frameworks of educational leadership have relied on a rich body of organizational theory literature arguing that leadership cannot be separated from its context (Spillane et al., 2001, 2004). As noted by Spillane et al. (2001), 'to study school leadership we must attend to leadership practice rather than chiefly or exclusively to school structures, programs, and designs' (p. 23). One of the core conceptual shifts has been to move school leadership outside of the domain of being a positional function, such as the specific role of the principal (Hallinger & Murphy, 1985), and instead to reposition school leadership as a function of the organization (Gronn, 2002a, 2002b; Marks & Printy, 2003; Printy et al., 2009; Spillane et al., 2001, 2004).

Along with this newer conception of school leadership comes a new conceptualization of who school leaders are. The classic model of a school leader was positional: the principal was the school leader (Hallinger & Murphy, 1985; Krüger & Scheerens, 2012). However, if school leadership is an organizational function rather than a positional attribute, then the concept of having a single school leader no longer makes sense (Gronn, 2002a, 2002b; Halverson et al., 2014; Marks & Printy, 2003; Printy et al., 2009; Spillane et al., 2001, 2004). Instead of having a single school leader with many followers, everyone at the school who is engaging in leadership functions is him-/herself a leader (Gronn, 2002a, 2002b; Leithwood et al., 2009; Spillane et al., 2001; 2004). This conception of school leadership as shared instructional leadership has led to the identification of school faculties consisting of both formal and informal leaders (Marks & Printy, 2003; Printy et al., 2009; Urick & Bowers, 2014b) and, importantly for the present study, teachers collectively taking action as faculties in enacting school leadership functions (Bowers et al., 2017, Urick, 2012).

School leadership extends beyond individual school leaders (Gronn, 2002a, 2002b; Halverson et al., 2014; Spillane et al., 2001, 2004). The overarching goal of leadership for learning frameworks is to provide a foundation to ensure that schools are collectively focused on what is necessary to ensure the success of their students (Hallinger, 2011; Halverson & Dikkers, 2011; Knapp et al., 2003; Murphy et al., 2006, 2007). Murphy et al. (2006, 2007) talk about the importance of shifting from an individual leadership model to a team leadership model to improve the overall performance of schools. This includes the creation of both formal and informal leadership roles for teachers in schools (Murphy et al., 2006, 2007).

Educational leadership research has grappled with a number of methodological problems in modeling and assessing school leadership (Hallinger & Heck, 1996, 2011; Heck & Hallinger, 2009, 2010, 2014). Hallinger and Heck (1996) reviewed fifteen years of educational leadership research and determined that the collected findings demonstrated that there was seemingly little to no leadership effect in schools when school leadership was modeled as a direct effect between principals and students. Hendriks and Stein (2012) reached similar conclusions regarding school leadership methodologies and their effectiveness in measuring school leadership. In the first part of their meta-study, Hendriks and Stein (2012) found that the vast majority of educational leadership literature did not provide statistically significant evidence that principal leadership behaviours have a direct impact on student achievement. However, many of the indirect effects models which found significant yet indirect effects of school leadership on student achievement included teachers in their models, such as collaborative leadership

practices (Heck & Moriyama, 2010), teacher participation in decision-making (Leithwood & Jantzi, 2008), shared values between principals and teachers on academic climate (De Maeyer, Rymenans, van Petegem, van den Bergh, & Rijlaarsdam, 2007), and various types of teacher commitment (Ross & Gray, 2006). Overall the findings of Hendriks and Stein (2012) support the need for better understandings of leadership pathways (Hallinger & Heck, 2011) that include teachers.

Educational leadership research has historically been split between examining teacher perceptions at the individual level or aggregated to the school level (Leithwood & Jantzi, 2008; Rowan, Raudenbush, & Kang, 1991). There can be marked differences between individual perspectives, preferences, and beliefs and various norms, processes, and beliefs that are shared collectively by a group (Avolio & Bass, 1995; Dorfman, Hanges, & Brodbeck, 2004; Leithwood & Jantzi, 2008; Urick & Bowers, in press). Education research that focuses exclusively on schools, the collective level of analysis, can disempower the lived experiences of the individuals who are essential to the overall functioning of the collective body (James & Jones, 1974; Pallas, 1988; Rowan, Raudenbush, & Kang, 1991). At the same time, focusing exclusively on the individuals without attending to collective factors that are only present at the school level can ignore powerful and meaningful effects on students, teachers, and principals (Bryk & Driscoll, 1988; Pallas, 1988; Rowan, Raudenbush, & Kang, 1991).

Educational leadership research has moved toward employing multilevel analysis to measure leadership practices at the individual and collective levels simultaneously (Bowers, et al., 2017; Heck & Hallinger, 2009, 2014; Raudenbush & Bryk, 2002; Urick & Bowers, 2011, 2014, in press). This simultaneous modeling of individuals and organizations corrects past methodological errors while enabling new conceptual questions to be explored (Hallinger & Heck, 2011; Heck & Hallinger, 2009, 2014; Raudenbush & Bryk, 2002; Urick & Bowers, 2011, 2014, in press). Hallinger and Heck (1996) alluded to the value of multilevel modeling nearly twenty years ago in their review of educational leadership literature:

> We believe that researchers of administrative effects will also profit greatly from adopting a multilevel perspective toward schools as organizations…. Treating data within its hierarchical structure may assist in building theory about the nature of administrator effects across levels of the organization. It will also facilitate more refined investigations into a wider variety of theoretical perspectives on how impact is obtained in different types of organizational structure…. (p. 34)

Since Hallinger and Heck (1996) published their review, multilevel modeling methodologies across the research literature have allowed for collective effects to be modeled without aggregating individual teacher responses. Or, said another way, the research literature now allows for individuals' lived experiences to be included in a manner that accounts for shared contexts, and for accurate comparisons to be made between the individual and collective levels (Hox, 2010; Kaplan & Elliott, 1997; Rowe & Hill, 1998; Raudenbush & Bryk, 2002; Rowan et al., 1991; Rumberger & Palardy, 2004). Through their increasing use across the field of education research literature, multilevel modeling techniques create new opportunities for connecting complex theoretical leadership frameworks with the equally complex reality of the leadership being an organizational function and an individual endeavor (Hallinger & Heck, 2011; Heck & Hallinger, 2009, 2014; Raudenbush & Bryk, 2002; Urick & Bowers, 2011, 2014, in press).

Conceptual framework

The present study is grounded in organizational theory literature specifically focused on how individual and collective constructs differ across levels of organizations and how to model these differences (Bliese, 2000; Chen, Bliese, & Mathieu, 2005; Dyer, Hanges, & Hall, 2005; Kozlowski & Klein, 2000). We applied Dyer et al.'s (2005) conceptual framework for multilevel factor analysis in particular, as it was designed to provide a theoretical framework in support of leadership research. Multilevel factor analysis is an attractive innovation in the multilevel modeling methods research that has been increasingly employed in recent education research (Muthén, 1991, 1994; Muthén & Asparouhov, 2011). In short, multilevel factor analysis simultaneously examines the individual, as well as organizational collective level, factors across survey response items, providing a means to appropriately nest individuals within organizations while providing separate factor structures at the individual and collective levels (Muthén, 1991, 1994; Muthén & Asparouhov, 2011). The creation of separate individual and group-level estimates of factor structures offers key insights into the differences between how individuals and organizations interact with one another and how different perception of leadership exist across organizational levels (Dyer et al., 2005).

Dyer et al. (2005) describe a typology of three different types of factors at the collective level: *composition factors* in which a collective factor is isomorphic to an individual-level factor and the two mirror each other, *compilation factors* in which a collective factor is not represented by any individual-level factor, and *fuzzy factors* in which a collective factor is somewhat isomorphic to an individual-level factor and the two may function similarly in practice, yet the underlying structure of the factors varies across the two levels.

This typology of cross-level factor comparisons is critical for building multilevel theories of leadership that are grounded in empirical evidence. This ties in directly to issues of aggregate construct validity and research being impeded by the lack of strong conceptual multilevel typologies (Chan, 1998; Chen, Bliese, & Mathieu, 2005; Dyer et al., 2005; Mumford, 1998). As explained by Dyer et al. (2005):

> Leadership researchers have questioned the extent to which relationships among constructs would vary at different levels of analysis as well as the extent to which constructs would have different meanings or factor structures at different levels of analysis. (p. 150)

> Most typically, either theoretical arguments are referenced to verify the [aggregate] construct, or an argument is made that the construct is valid because an adequate level of agreement in responses exists within the group. Few studies have used empirical techniques such as factor analysis to explore the validity of aggregate constructs in a manner that explicitly acknowledges the aggregate nature of the measure, while allowing for a simultaneous assessment of measurement qualities (e.g., factor loadings, factor intercorrelations) at both the aggregate and disaggregate levels of analysis. (pp. 151–152)

Past theoretical leadership frameworks have regularly assumed that individuals and collective bodies have similar understandings of leadership (Chan, 1998; Chen, Bliese, & Mathieu, 2005; Dyer et al., 2005; Mumford, 1998) despite the fact that there is a significant body of theoretical and empirical work that speaks to this assumption being inaccurate (Avolio & Bass, 1995; Chen et al., 2005; Dorfman, Hanges, & Brodbeck, 2004; Dyer et al, 2005). One of the primary reasons for this assumption has not been theoretical concerns, but rather methodological concerns (Chen et al., 2005; Dyer et al., 2005). Simply put, past leadership researchers have been hamstrung by lacking empirical methodologies that have been robust enough to rigorously explore multilevel theories (Chen et al., 2005; Dyer et al., 2005). Within educational leadership literature in particular, research into teacher leadership has been limited as 'the few large-scale quantitative studies that do exist... have exposed dilemmas in attempting to define teacher leadership in ways that make quantification possible and meaningful' (York-Barr & Duke, 2004, p. 287).. Past researchers have made deliberate efforts to demonstrate the value of multilevel factor analysis in addressing these past concerns (Chen et al., 2005; Dyer et al., 2005). This study follows a similar line of education research (D'Haenens et al. 2010; Dunn et al., 2014), aiming to add novel contributions to the field of educational leadership while also showcasing the value and accessibility of multilevel factor analysis methodologies.

Thus, the present study combines rigorous methodology, the framework of leadership for learning, and a dataset that spans across different domains within the leadership for learning framework to address the following research question: to what extent are there differences between how individual teachers and teachers collectively perceive of leadership for learning in their schools?

METHODS:

Data, statistical weights, & analytic sample

This study is a secondary data analysis of the 2011–12 Schools and Staffing Survey (SASS) administered by the National Center for Educational Statistics (NCES) within the US Department of Education (Goldring, Gray, & Bitterman, 2013; Goldring, Taie, Rizzo, Colby, Fraser, & Chandler, 2013). We selected the 2011–12 SASS dataset for this study for three reasons. First, SASS provides a unique opportunity to examine leadership for learning given its alignment with the leadership for learning theoretical framework (Boyce & Bowers, in press). Second, SASS is generalizable to the USA population of teachers through the use of sampling weights (Goldring et al., 2013), which allows the present study to explore teachers' perspectives nationwide. Third, prior quantitative research using SASS data has shown SASS to be amenable to both mixture modeling (including factor analysis) and multilevel analysis, providing significant insights into a variety of research areas related to educational leadership (Boyce & Bowers, in press). To ensure confidentiality of the results, all sample sizes have been rounded to the nearest ten and all statistics directly describing the data have been rounded to the nearest hundredth (NCES, 2011a).

The data used in this study are a subset of the full sample of public school teachers and public schools included in the 2011–12 SASS dataset. We applied multilevel sampling weights throughout our analysis, which limited our sample to include only teachers with the requisite sample weighting data for multilevel modeling (Asparouhov, 2006; Asparouhov, Muthén, & Muthén, 2004). This resulted in an analytic sample of n=34,850 teachers (93% of the teachers within the teacher data file) within n=7,070 schools (94% of the schools within the school data file).

Variables included in the analysis

We based our variable selection for this study on prior literature on leadership for learning as reviewed above. In reviewing the 2011–12 SASS Public School Teacher survey we focused on identifying question items that related to teacher perceptions and self-reports of the following areas (Boyce & Bowers, in press; Halverson & Dikkers, 2011; Kelley & Halverson, 2012; Murphy et al., 2006, 2007): teacher influence, teacher leadership, school leadership, school climate, teacher satisfaction, and teacher commitment. This resulted in the selection of 49 question items to be included in the present study as indicators for our multilevel factor analyses.

We provide a summary of the question items below. As recommended by prior multilevel factor analysis research, some question items were reverse-coded to aid in both modeling convergence and interpretation of the results (D'Haenens, van Damme, & Onghena, 2010; Gustafsson & Stahl, 2005). We conducted our reverse-coding process to create a consistent response structure in which a greater numerical response corresponded with a more positive interpretation (D'Haenens et al., 2010). Additionally, all indicators were dichotomized to aid with model convergence and to provide a more conservative estimate of the number of factors within the data (Barendse, Oort, & Timmerman, 2015). A full list of the question items, their SASS question codes, how their responses were coded, whether their responses were reversed, and their unweighted descriptive statistics can be found in Appendix A.

Teacher self-reports of school-level influence: The 2011–12 SASS included seven questions asking teachers to report their self-perceptions of how much influence they have in their schools across different functions (Boyce & Bowers, in press; Halverson & Dikkers, 2011; Kelley & Halverson, 2012; Murphy et al., 2007; NCES, 2011b). The survey asked teachers to respond on a four-point Likert scale that we dichotomized into either high influence (1 = *Moderate influence* or higher) or low influence (0 = *Minor influence* or lower).

Teacher self-reports of classroom-level control: The 2011–12 SASS included six questions asking teachers to report their self-perceptions of how much control they have in their classrooms across different functions (Boyce & Bowers, in press; Halverson & Dikkers, 2011; Kelley & Halverson, 2012; Murphy et al., 2007; NCES, 2011b). The survey asked teachers to respond on a four-point Likert scale that we dichotomized into either high control (1 = *Moderate control* or higher) or low control (0 = *Minor control* or lower).

Teacher attitudes: The 2011–12 SASS included twenty-five questions asking teachers how much they agreed or disagreed with a variety of different statements (Boyce & Bowers, in press; Halverson & Dikkers, 2011; Kelley & Halverson, 2012; Murphy et al., 2007; NCES, 2011b). The survey asked teachers to respond on a four-point Likert scale: 1 = *Strongly agree*, 2 = *Somewhat agree*, 3= *Somewhat disagree*, and 4 = *Strongly disagree*. Since agreement responses were recorded in the survey as being lower numbers, question items that reflected positive attitudes about the school (e.g., 'The school administration's behavior toward the staff is supportive and encouraging.') were reverse-coded so that agreement with a positive statement was a numerically greater answer. Responses were then dichotomized into negative attitude (0 = *Strongly* or *Somewhat agree* after reverse-coding) or positive attitude (1 = *Strongly* or *Somewhat disagree* after reverse-coding).

Teacher perceptions of school problems: The 2011–12 SASS included ten questions asking teachers for their perceptions of the magnitudes of certain types of problems in their schools (Boyce & Bowers, in press; Halverson & Dikkers, 2011; Kelley & Halverson, 2012; Murphy et al., 2007; NCES, 2011b). The survey asked teachers to respond on a four-point Likert scale that we dichotomized into large problems (0 = *Moderate problem* or worse) or small problems (1 = *Minor problem* or better).

Teacher commitment: The 2011–12 SASS included one question item that directly asked teachers about their professional commitment (Boyce & Bowers, in press; Halverson & Dikkers, 2011; Kelley & Halverson, 2012; Murphy et al., 2007; NCES, 2011b): 'If you could go back to your college days and start over again, would you become a teacher or not?' The survey asked teachers to respond on a five-point Likert scale that we reverse-coded and dichotomized into high professional satisfaction (1 = *Probably would become a teacher* or higher) or low professional satisfaction (0 = *Chances about even for and against* or lower).

Analysis

In the present study we performed a four-fold cross-validation multilevel factor analysis (Dunn et al., 2014; Dyer et al., 2005; Muthén 1991, 1994; van der Gaag et al., 2006). Multilevel factor analysis is a quantitative method that belongs to the statistical family of mixture modeling (Muthén 1991, 1994; Muthén & Asparouhov, 2011). The underlying assumption of mixture modeling is that there is latent information present within a dataset that explains how the data are structured. The process of performing a multilevel factor analysis is to examine a set of observed data, or indicators, and testing to what extent these observed data could be explained by a smaller set of latent variables, or factors (Chen et al., 2005; Dyer et al., 2005; Muthén 1991, 1994; Muthén & Asparouhov, 2011). Specific to social science applications, this type of analysis helps to uncover deeper cognitive, emotional, and social processes that are not readily apparent at the surface level of survey question items (Chen et al., 2005; Dunn et al., 2014; Dyer et al., 2005, Muthén, 1994; Urick & Bowers, in press). Additionally, multilevel factor analysis models the nested nature of teachers within schools in a way that is statistically accurate by controlling for the dependent nature of the data, appropriately nesting teachers within schools (Muthén 1991, 1994; Hox, 2010; Raudenbuch & Bryk, 2002) and thus provides an opportunity to explore differences between how individuals and collective bodies differ in how they make sense of their environments (Chen et al., 2005; Dunn et al., 2014; Dyer et al., 2005; Urick & Bowers, in press).

We employed cross-validation to address potential drawbacks of purely exploratory factor analysis (Arlot & Celisse, 2010; Breiman & Spector, 1992; Kohavi, 1995; Zhang, 1993), such as difficulty generalizing to the population of interest due to over-fitting (Dunn et al., 2014; Thompson, 2004). Given past work in using cross-validation in conjunction with factor analysis (van der Gaag et al., 2006), we selected V-fold cross-validation (Arlot & Celisse, 2010; Breiman & Spector, 1992; Kohavi, 1995; Zhang, 1993).

When performing V-fold cross-validation it is important to choose a suitable number of folds as different numbers of folds have different impacts on the bias of the exploration (Arlot & Celisse, 2010; Breiman & Spector, 1992; Kohavi, 1995; Zhang, 1993). Based on past literature (Arlot & Celisse, 2010; Breiman & Spector, 1992; Kohavi, 1995; Zhang, 1993), our sample size, and the limitations of our computing power (as some of these models can take days of processing time on the current technology available), we selected a four-fold cross-validation process. Following past recommendations (Bell, Ferron, & Kromrey, 2008; Maas & Hox, 2005), we randomly divided our 2011–12 SASS sample of 7,070 schools into four subsets of 1,770 schools, each with approximately five teachers per school on average.

We began with the full analytic sample of 7,070 schools. Then we randomly split the full analytic sample into four subsamples of 1,770 schools. We built our four exploratory subsamples by

combining three of the four subsets. For example, one of our exploratory subsamples is comprised of random subsamples one, two, and three. Our other exploratory subsamples were built similarly. Then we set our confirmatory subsamples to be equal to our random subsamples. This created four exploratory subsamples that were each equal to 75% of the full analytic sample and four confirmatory subsamples that were each equal to 25% of the full analytic sample.

Analytic model

Guided by past research (Dunn et al., 2014; Dyer et al., 2005; Muthén 1991, 1994; van der Gaag et al., 2006), we conducted the four-fold cross-validation multilevel factor analysis in four different stages. First, we calculated the intraclass correlation coefficients (ICCs) for each indicator variable among the four exploratory samples. ICCs estimate the amount of variance that is present between groups (Dunn et al., 2014; Dyer et al., 2005; Muthén, 1994). Based on recommendations from the literature (Dyer et al., 2005), we looked for a large number of our indicators to have ICC's consistently above 0.05 across the four exploratory datasets to ensure there was meaningful variance to justify the appropriateness of multilevel modeling (Muthén, 1994).

Second, we performed separate within-level and between-level MEFAs on each of the exploratory samples (Dunn et al., 2014). In selecting the number of factors at each level, we used Kaiser's criterion (D'Haenens et al., 2010; Dunn et al., 2014) to guide us in only examining factors with eigenvalues greater than or equal to one (Bandalos & Boehm-Kaufman, 2009; Dunn et al., 2014; Hayton, Allen & Scarpello, 2004). The three measures for evaluating the best model fit at this stage were the comparative fit index (CFI), root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR) (Bentler, 1980, 1992; Dunn et al., 2014; Jöreskog & Sörbom, 1981; Muthén & Muthén, 1998; Steiger, 1990). Chi-squared can also be used for model fit, however for larger sample sizes it is often significant and therefore is often not used as one of the primary indicators (Dunn et al., 2014). Based on the literature (Browne & Cudeck, 1993; Dunn et al., 2014; Hu & Bentler, 1999; Kline, 2010; MacCallum, Browne, & Sugawara, 1996; Marsch, Hau & Wen, 2004; Stieger, 1990), our fit criteria included a CFI above 0.900, RMSEA below 0.060, and SRMR below 0.080, indicating adequate model fit. Beyond these quantitative measures, we also evaluated models with respect to their interpretability, the number of indicators that have significant loadings on more than one factor, and how distinct the factors were from one another (Brown, 2014; D'Haenens et al., 2010; Dunn et al., 2014; Kline, 2010). We considered significant factor loadings to be above |0.32| and strong factor loadings to be above |0.50| (Dunn et al., 2014).

Third, after determining the number of factors at each level individually, we performed MEFAs on each of the exploratory samples with factors at both the within and between levels to confirm whether or not a model with factors at both levels had adequate fit (Dunn et al., 2014). During this stage we also evaluated whether or not certain indicators should be removed in order to improve model fit (Brown, 2014; Dunn et al., 2014; Kline, 2010). There are two criteria by which an indicator may be removed at this stage. The first criterion is that an indicator may not contribute much explanatory power to the overall model if (a) it does not have any strong factor loadings and (b) it does not have two or more significant factor loadings (Dunn et al., 2014). While cross-loaded indicators are often removed when conducting factor analysis, our exploratory framework (Dunn et al., 2014) instead interprets them as modeling the overlapping nature of psychological, social, and behavioral factors in education. The second criterion for removing an indicator from the model is that the indicator may not load consistently with the same items across the four exploratory samples.

Fourth, the final stage of the analysis was cross-validation. Using the loadings from the MEFAs in stage three, we conducted MCFAs on the four confirmatory samples. The MCFAs were performed in an iterative manner until adequate model fit had been achieved (van der Gaag et al., 2006). The first MCFA included only significant and strong factor loadings that were found in four exploratory samples in stage three. Then we added factor loadings that were significant in three of the four exploratory samples to the model for the next set of MCFAs, and so on until adequate model fit was achieved. The goal of this iterative process was to have the resulting MCFA model be both parsimonious and accurate to the data (Dunn et al., 2014; van der Gaag et al., 2006).

We used Mplus version 7.11 (Muthén & Muthén, 2013) to analyse the models. Given recent literature on different estimators (DiStefano & Morgan, 2014), we used weighted least squares–mean and variance adjusted (WLSMV) estimation for our analysis (Dunn et al., 2014). The MEFAs were performed with a geomin oblique rotation, which was justified given the inter-factor correlations (D'Haenen's et al., 2010).

RESULTS:

The purpose of the present study is to investigate the differences between how individual teachers and teachers collectively perceive of leadership for learning in their schools as a means to understand the complexity of the practice of school leadership. We conducted the cross-validation multilevel factor analysis in four different stages. Stage one examined the intraclass correlation coefficients of the 49 indicators and determined that there was significant variation between schools, indicating that multilevel modeling was well-suited for these data. Stage two used MEFAs to conclude that individual teachers perceived of six different leadership for learning factors while teachers collectively perceived of three factors. Stage three confirmed that the six within-level and three between-level model fit the data well and trimmed ten indicators to improve model fit and parsimony. Stage four cross-validated the final model from stage three.

The processes and results of each stage are detailed below. We report fit statistics, model selection comparisons, incremental indicator additions and removals, and both the final exploratory and final confirmatory factor structures following the past MLFA and cross-validation literature (Dunn et al., 2014; Dyer et al., 2015; D'Haenens et al, 2010; Muthén, 1994; van der Gaag et al, 2006). Structured reporting of intermediate MLFA statistics supports the ability to understand the underlying complexity of the data and the appropriateness of the final MCFA model (Dyer et al., 2005; Muthén, 1994). We then turn to the interpretation and discussion of the final validated multilevel confirmatory factor analysis in the discussion.

Stage one – examining multilevel variance across items
Stage one consisted of calculating and reviewing the intraclass correlation coefficients (ICCs) of all 49 indicators in each of the four randomly split exploratory subsamples. ICCs measure the amount of variance that occurs between schools at the between-level compared to the amount of variance that occurs between individual teachers at the within-level. Past literature recommends having ICCs of at least 0.05 on most of the indicator variables to establish that the data are well-suited to multilevel factor analysis (Dyer et al., 2005).

Appendix B provides the ICCs for all indicators in each of the exploratory samples. All 49 indicators have ICCs above 0.05 in all four exploratory samples. This suggests that multilevel factor analysis is an appropriate method to use in analysing these data. Moreover, the ICCs vary from 0.061 to 0.614. The variation in the ICCs suggests that different variables may be more likely to have strong factor loadings at the within-level while others may be more likely to have strong factor loadings at the between-level, resulting in different factor structures at each level (Dunn et al., 2014). This finding lends further evidence to the justification for a multilevel model of these data.

Stage two – assessing the appropriate number of factors at level 1 and level 2 independently of one another
Stage two consisted of exploring the number of factors at the within school level (i.e., individual teacher level) and between school level (i.e., collective teacher level) separately using MEFA on each of the four exploratory subsamples. This is the first step in exploring the structure of how individual teachers and teachers collectively perceive of leadership for learning in their schools. The final product of stage two is the initial multilevel factor model that will be evaluated in detail during stage three. Fit statistics for the models using exploratory sample four can be found in Appendix C as a representation of our analysis for this stage.

The eigenvalues for the possible within-level individual teacher factors were calculated using the four exploratory samples. Kaiser's criterion provided an upper limit of ten within-level factors in all four samples. We generated fit statistics for models with between one and ten within-level factors for each sample (e.g., Appendix C Panel A). The models with eight and ten within-level factors did not converge across all of the exploratory samples. Based on this, we eliminated models with eight or more within-level factors from consideration given these convergence issues. Following the recommendations of the literature noted in the methods, we then used our model fit criteria of CFI above 0.900, RMSEA below 0.060, and $SRMR_{within}$ below 0.080 as our initial cutoff for determining which models fit the samples adequately. In all four samples the models with between five and seven within-level factors had adequate model fit based on these criteria. We examined these models in detail. We eliminated the model with five factors because in all four samples it included a factor that consisted entirely of cross-loaded indicators. In comparing the six- and seven-factor models, the six-factor model had similar yet consistently fewer cross-loaded indicators (1, 1, 2, 2) across the four exploratory samples compared to the seven-factor model (2, 3, 3, 4). Additionally, the seven-factor model did not add significantly more interpretability to the model and the indicators that had strong loadings on the seventh factor had strong loadings on other factors in the six-factor model. Given this analysis, we selected the six-factor model to move forward with in terms of selecting the number of within-level factors.

The eigenvalues for the possible between-level collective teacher school-level factors were calculated using the four exploratory samples. Kaiser's criterion provided an upper limit of nine between-level factors in three samples and an upper limit of eight in one sample. Based on these results, we generated fit statistics for models with between one and nine between-level factors for each sample to err on the side of being thorough in our model evaluation (e.g., Appendix C Panel B). We used our model fit criteria of CFI above 0.900, RMSEA below 0.060, and $SRMR_{between}$ below 0.080 as our initial cutoff for determining which models fit the samples adequately. In all four samples the models with between three and nine between-level factors had adequate model fit based on these criteria. We examined these models in detail. We eliminated the models with between seven and nine between-level factors because in all four exploratory samples they included factors that consisted of either all or all-but-one cross-loaded indicators. We eliminated models with either five or six factors because they included factors that consisted of all-but-one cross-loaded indicators in at least one exploratory sample. In choosing between the three-factor and four-factor models, we preferred the three-factor model because its numbers of cross-loaded indicators were 10, 10, 12, and 14 across the four exploratory samples, which were fewer than the four-factor model's 14, 15, 16, and 17 cross-loaded indicators. Given this analysis, we selected the three-factor model to move forward with in terms of selecting the number of between-level factors.

At the conclusion of stage two, we determined that, at the within-level of analysis, individual teachers perceive of leadership for learning as six distinct factors. We also concluded that at the between-level of analysis teachers collectively perceive of leadership for learning as three distinct factors. This suggested that a fully specified multilevel factor structure of six

within-level factors and three between-level factors would fit the data well.

Stage three – assessing full MEFA model fit across the exploratory subsamples and trimming indicators

In stage two, we determined that individual teachers perceived leadership for learning as a collection of six different factors at level 1, the individual teacher level, and that teachers collectively perceived of leadership for learning as a collection of three different factors at level 2, the collective teacher level. In stage three, we examined whether or not the combined model of six within-level individual teacher factors and three between-level collective teacher school factors fit the four exploratory subsamples as our primary foundation for the cross-validation as noted above in the methods. In doing so we conducted multiple trims of the data to improve model fit and interpretability. Model fit statistics for all models run in this stage are listed in Appendix D.

The six within-level factors and three between-level factors model fit the data well on all four exploratory samples with CFI's above 0.900, RMSEA's below 0.060, and SRMR's below 0.080. Thus, the stage two multilevel exploratory factor analyses worked well, as the fully specified multilevel exploratory factor analysis fit all exploratory subsamples.

Having confirmed adequate model fit, we next reviewed the factor loadings to determine whether or not specific indicators should be trimmed from the model as recommended by past literature to ensure a final parsimonious best fit model (Brown, 2014; Dunn et al., 2014; Kline, 2010). In the first round of trimming we removed indicators that did not have loadings that significantly added to the overall model. The specific requirements for making the determination is that the indicator (a) did not have any strong factor loading on any factor at either the within or between levels and (b) did not have two or more significant factor loads on any factors at either the within or between levels (Dunn et al., 2014). The cutoff for a strong factor loading was |0.50| and the cutoff for a significant factor loading was |0.32| (Dunn et al., 2014). We removed seven question items based on them not fulfilling these criteria in one or more of the exploratory samples: T0436, T0437, T0439, T0440, T0448, T0449, and T0452.

We reran the models across all four exploratory samples with these seven items removed, leaving 42 indicators in the model. The model fits improved slightly with the smaller number of indicators. We reviewed the models again in detail to evaluate whether or not more indicators should be trimmed based on not having significant loadings in the model. There were no new indicators to remove based on this criterion. We then reviewed indicators to determine whether or not any should be removed based on having inconsistent loadings across the four exploratory samples. 31 of the 42 indicators had the same loading structures across all four models. In reviewing the other eleven indicators, we wished to err on the side of not over-trimming the model given that the cross-validation process allows for variation between loadings. We identified three indicators as (a) not having any consistent strong loadings across the four exploratory models and (b) having at least three distinct factor loading structures across the four exploratory models. We removed these three indicators: T0431, T0458, and T0469.

We reran the models across all four exploratory samples with these three additional indicators removed, leaving 39 indicators in the model. The model fits improved slightly with the smaller number of indicators. We reviewed the models again in detail to evaluate whether or not any additional indicators should be trimmed, and we determined that there was no need to trim any other indicators.

The conclusion of stage three was an exploratory multilevel factor structure presented in Table 1. This model includes six within-level factors (representing individual teachers' perceptions) and three between-level factors (representing teachers' collective perceptions) of leadership for learning based on 39 of the original 49 indicators from SASS. We report the model resulting from stage three as recommended by past literature (Dunn et al., 2014), but we do not formally interpret the model until it has undergone cross-validation (van der Gaag et al., 2006). In stage four we take the model detailed in Table 1 and cross-validate it on the confirmatory subsamples using iterative multilevel confirmatory factor analyses as described previously in the methodology section.

Stage four – fitting the final multilevel confirmatory factor analysis model

The prior three stages were exploratory in their purposes. The result of all three of those stages is a set of multilevel models with the goal of describing the underlying factor structures of both individual teachers and teachers collectively. The fourth and final stage of this process is to cross-validate this exploratory work by performing MCFAs of these models on the confirmatory samples. Complete fit statistics for all models in this stage are listed in Appendix E.

Our initial model for the MCFA only included factor loadings that were significant across all four exploratory models. Since 33 of our indicators had entirely consistent loading patterns, the vast majority of the significant loadings from stage three were included in this model. None of the models at this stage met our criteria for adequate model fit. The average RMSEA of 0.027 was readily beneath the desired 0.060. $SRMR_{within}$ was borderline, averaging 0.078 across the models with a desired maximum of 0.080. CFI averaged 0.833, under the desired 0.900 or greater, and $SRMR_{between}$ averaged 0.149, above the desired 0.080 or lower.

In our second model for the MCFA we added in factor loadings that were significant across three of the four exploratory models. This resulted in three between-level factor loadings being added to the model. CFI, RMSEA, and $SRMR_{within}$ did not change significantly. However, $SRMR_{between}$ did drop significantly to an average of 0.130, a marked improvement.

Table 1: Multilevel exploratory factor analysis model, exploratory subsample four

Indicator	Within level (individual teachers)						Between level (collective teachers)		
	Factor 1 School Influence	Factor 2 Classroom Control	Factor 3 Collegial Climate	Factor 4 Student Attend.	Factor 5 Neigh. Context	Factor 6 Teacher Commit.	Factor 1 Instruct. Leadership	Factor 2 Managem.	Factor 3 Social Env.
T0423: Evaluating	**0.837**	-0.046	-0.004	-0.010	0.041	-0.026	**0.381**	**0.395**	-0.178
T0424: Hiring	**0.683**	-0.041	0.029	0.001	-0.014	-0.010	**0.388**	0.201	0.057
T0426: Budget	**0.669**	0.057	0.007	-0.028	0.015	-0.003	0.093	**0.393**	-0.028
T0425: Discipline	**0.642**	0.028	0.155	0.040	-0.013	0.018	0.189	**0.631**	-0.094
T0422: In-service PD	**0.632**	0.050	0.105	0.029	-0.016	0.022	**0.350**	**0.447**	-0.028
T0420: Performance standards	**0.575**	0.185	0.047	0.022	-0.007	0.042	**0.634**	**0.417**	-0.020
T0421: Curriculum	**0.573**	**0.335**	-0.051	0.000	0.002	0.011	**0.903**	0.006	-0.030
T0428: Content	0.097	**0.811**	-0.074	-0.064	0.062	-0.047	**0.930**	-0.177	-0.058
T0429: Teaching	0.020	**0.793**	0.044	0.035	-0.021	0.043	**0.768**	0.034	0.143
T0430: Grading	-0.021	**0.745**	0.081	0.006	-0.029	0.021	**0.726**	0.003	-0.014
T0432: Homework	-0.066	**0.675**	0.161	0.043	-0.012	0.001	**0.476**	-0.050	0.028
T0427: Textbooks	0.155	**0.635**	-0.02	-0.024	0.044	-0.020	**0.803**	-0.086	0.036
T0444: Principal knows	0.060	-0.038	**0.800**	0.008	0.017	-0.036	-0.138	**0.859**	-0.101
T0441: Principal enforcement	0.058	0.027	**0.745**	0.106	-0.022	0.016	0.006	**0.817**	-0.010
T0467: Like how school is run	0.029	0.014	**0.742**	0.052	-0.032	0.208	0.124	**0.890**	0.026
T0435: Admin support	0.044	0.066	**0.730**	0.038	-0.099	0.081	0.150	**0.856**	-0.157
T0445: Cooperative effort	-0.011	-0.020	**0.701**	-0.067	0.161	-0.022	-0.026	**0.827**	0.076
T0446: Recognition	0.083	0.031	**0.684**	-0.062	0.086	0.045	0.028	**0.866**	-0.057
T0443: Shared beliefs	-0.036	-0.048	**0.625**	-0.069	0.231	-0.090	-0.198	**0.691**	0.248
T0466: Like being here	-0.044	0.003	**0.617**	-0.020	0.034	0.264	**0.282**	**0.779**	0.082
T0442: Teacher enforcement	0.063	-0.061	**0.593**	0.038	0.217	-0.053	-0.214	**0.688**	0.280
T0451: Generally satisfied	-0.045	0.074	**0.557**	0.002	-0.024	**0.438**	**0.314**	**0.663**	0.189
T0455: Tardiness	0.053	-0.057	-0.021	**0.902**	-0.011	0.013	0.017	0.206	**0.718**
T0456: Absenteeism	0.026	-0.017	0.000	**0.849**	0.122	-0.033	0.017	0.127	**0.866**
T0457: Cutting	-0.037	0.017	0.043	**0.802**	0.106	-0.005	-0.147	0.264	**0.662**
T0450: Tardiness/cutting	-0.005	0.052	-0.024	**0.626**	-0.020	0.109	-0.037	0.208	**0.758**

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T0461: Parent involvement	0.033	0.002	0.011	-0.006	**0.819**	0.034	0.214	0.002	**0.880**
T0463: Unprepared to learn	0.012	0.035	0.020	0.081	**0.796**	0.065	0.212	0.036	**0.892**
T0462: Poverty	0.001	-0.019	-0.084	-0.008	**0.762**	-0.025	0.245	-0.127	**0.813**
T0460: Student apathy	0.058	-0.020	0.038	0.084	**0.650**	0.055	-0.007	0.198	**0.800**
T0464: Student health	-0.092	0.037	-0.023	0.096	**0.608**	0.019	0.239	-0.079	**0.844**
T0459: Dropping out	-0.067	0.047	0.054	0.275	**0.469**	-0.040	-0.084	0.100	**0.789**
T0438: Parent support	0.092	0.039	0.166	-0.044	**0.319**	0.108	**0.322**	-0.005	**0.833**
T0468: Leave for higher pay	0.016	-0.017	-0.040	-0.024	0.001	**0.779**	**0.433**	0.163	0.216
T0470: Less enthusiasm	0.072	-0.032	0.056	-0.002	0.038	**0.680**	**0.498**	0.252	0.174
T0472: Become a teacher again	0.104	-0.033	-0.049	-0.036	0.042	**0.666**	**0.333**	0.114	0.234
T0465: Stress	-0.040	0.029	0.251	0.063	-0.022	**0.649**	**0.450**	**0.477**	0.278
T0471: Consider staying home	0.001	-0.011	0.057	0.006	0.079	**0.588**	**0.467**	0.263	0.201
T0447: Job security	-0.011	0.150	-0.090	0.105	0.116	0.196	**0.498**	-0.013	**0.414**

Factor correlations

Between level, collective teachers	Factor 1	Factor 2	Factor 3
Factor 1 Instructional Leadership	1.000		
Factor 2 Management	0.220	1.000	
Factor 3 Social Environment	0.071	0.382	1.000

Within level, individual teachers	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Factor 1 School Influence	1.000					
Factor 2 Classroom Control	0.360	1.000				
Factor 3 Collegial Climate	0.447	0.257	1.000			
Factor 4 Student Attendance	0.101	0.161	0.227	1.000		
Factor 5 Neighborhood Context	0.198	0.147	0.260	0.490	1.000	
Factor 6 Teacher Commitment	0.239	0.268	0.349	0.226	0.261	1.000

Note: All factor loadings are standardized. Bolded loadings were included in the final MCFA. All bolded loadings are significant at $p < 0.05$.

Table 2: Final multilevel confirmatory factor analysis model, confirmatory subsample four

Indicator	Within level (individual teachers)						Between level (collective teachers)		
	Factor 1 School Influence	Factor 2 Classroom Control	Factor 3 Collegial Climate	Factor 4 Student Attend.	Factor 5 Neigh. Context	Factor 6 Teacher Commit.	Factor 1 Instruct. Leadership	Factor 2 Managem.	Factor 3 SocialEnv.
T0423: Evaluating	**0.781**						**0.281**	0.134	
T0424: Hiring	**0.622**						**0.582**		
T0426: Discipline	**0.685**							**0.371**	
T0425: Budget	**0.785**							**0.663**	
T0422: In-service PD	**0.762**						0.294	**0.369**	
T0420: Performance standards	**0.736**						**0.619**	0.309	
T0421: Curriculum	**0.526**	0.289					**0.655**		
T0428: Content		**0.748**					**0.488**		
T0429: Teaching		**0.838**					**0.887**		
T0430: Grading		**0.762**					**0.639**		
T0432: Homework		**0.733**					**0.397**		
T0427: Textbooks		**0.722**					**0.631**		
T0444: Principal knows			**0.788**					**0.690**	
T0441: Principal enforcement			**0.789**					**0.772**	
T0467: Like how school is run			**0.869**					**1.000**	
T0435: Admin support			**0.777**					**0.807**	
T0445: Cooperative effort			**0.686**					**0.893**	
T0446: Recognition			**0.784**					**0.859**	
T0443: Shared beliefs			**0.586**					**0.813**	
T0466: Like being here			**0.736**				0.299	**0.830**	
T0442: Teacher enforcement			**0.692**					**0.752**	
T0451: Generally satisfied			**0.512**			**0.395**	**0.400**	**0.772**	
T0455: Tardiness				**0.863**					**0.830**
T0456: Absenteeism				**0.921**					**0.920**
T0457: Cutting				**0.895**					**0.762**

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T0450: Tardiness/cutting				**0.623**					**0.863**
T0461: Parent involvement					**0.818**				**0.918**
T0463: Unprepared to learn					**0.887**				**0.949**
T0462: Poverty					**0.625**				**0.769**
T0460: Student apathy					**0.753**				**0.902**
T0464: Student health					**0.588**				**0.846**
T0459: Dropping out					**0.690**				**0.763**
T0438: Parent support					**0.558**		0.233		**0.747**
T0468: Leave for higher pay						**0.677**	**0.810**		
T0470: Less enthusiasm						**0.736**	**0.788**		
T0472: Become a teacher again						**0.644**	**0.725**		
T0465: Stress						**0.860**	**0.540**	**0.594**	
T0471: Consider staying home						**0.662**	**0.938**		
T0447: Job security							**0.470**		**0.325**

Factor correlations

Between level, collective teachers	Factor 1	Factor 2	Factor 3
Factor 1 Instructional Leadership	1.000		
Factor 2 Management	0.319	1.000	
Factor 3 Social Environment	0.328	0.475	1.000

Within level, individual teachers	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Factor 1 School Influence	1.000					
Factor 2 Classroom Control	0.516	1.000				
Factor 3 Collegial Climate	0.567	0.306	1.000			
Factor 4 Student Attendance	0.156	0.149	0.287	1.000		
Factor 5 Neighborhood Context	0.330	0.231	0.458	0.636	1.000	
Factor 6 Teacher Commitment	0.369	0.309	0.547	0.274	0.372	1.000

Note: All factor loadings are standardized. Bolded loadings met the |0.32| criterion for a significant factor loading in at least three of the confirmatory models. All loadings are significant at $p < 0.001$.

In our third model for the MCFA we added in factor loadings that were significant across two of the four exploratory models. This resulted in a single between-level factor loading being added to the model. The fit statistics did not significantly change.

In our fourth and final model for the MCFA included factor loadings that were significant in any single exploratory model, fitting the full MEFA model from stage three with six level 1 individual teacher factors and three level 2 collective teacher school factors. The final model fit the data reasonably well with an average CFI across the randomly split confirmatory subsamples of 0.886, average RMSEA of 0.023, average $SRMR_{within}$ of 0.064, and average $SRMR_{between}$ of 0.125.

Table 2 provides the factor loadings and factor correlations for the final multilevel confirmatory factor analysis, with six level 1 individual teacher factors and three level 2 collective teacher school factors at the between level. We report the factor loadings of the fourth confirmatory sample as that model had the best fit. For our interpretation of the MCFA results, we interpreted only factor loadings that met our criterion of |0.32| or higher for significant loadings in at least three of the four confirmatory models. Figure 1 illustrates the factor structure of both the within level (individual teachers) and the between level (teachers collectively). We detail our rationales for naming the factors below.

Working from left to right in Table 2, we named the first within-level individual teacher factor 'school influence' (Boyce & Bowers, in press). All seven question items from the 2011–12 SASS section asking teachers for self-reports of school influence were included in this factor and they were the only question items to be included in this factor. This factor represents the extent to which an individual teacher perceives herself as being able to influence aspects of her school.

We named the second within-level individual teacher factor 'classroom control' (Boyce & Bowers, in press) for similar reasons. The only difference is that one of the question items related to classroom control (classroom control over disciplining students, T0431) was removed from the model during the trimming in stage three, so not all of the classroom control question items were included in this factor. This factor represents the extent to which an individual teacher perceives herself as being able to control what happens in her classroom.

The third within-level individual teacher factor was significantly more diverse in its question items. The themes running through the question items include teacher's views on the principal, school administration, shared beliefs between the adults in the school, and use words such as 'supportive', 'encouraging', and 'recognized' in describing how the adults in the school relate to one another. We named this factor 'collegial climate' (Cohen & Brown, 2013) given the wide scope of the question items. This factor represents how an individual teacher perceives of her attitudes and her relationships with her fellow school staff.

We named the fourth within-level individual teacher factor 'student attendance' (Roby, 2004) There were four question items in the 2011–12 SASS that asked teachers about the extent to which student tardiness, absenteeism, and/or class cutting was a problem in the school and interfered with teaching. All four of these question items were included in this factor and they were the only question items to be included in this factor. This factor represents how an individual teacher perceives of student attendance in her school.

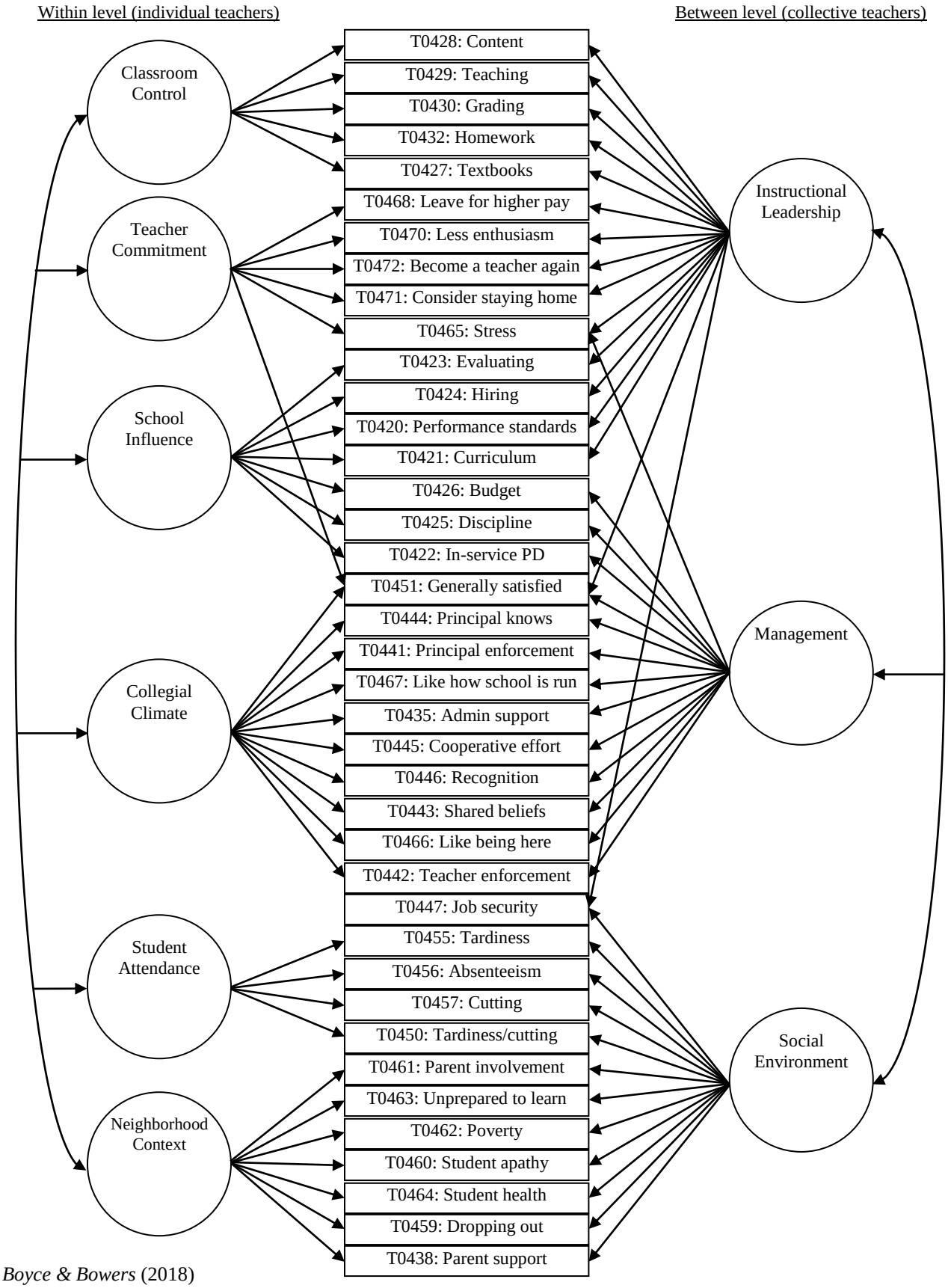
The fifth within-level individual teacher factor included question items related to parental support, student apathy, students coming to school unprepared, students dropping out, and non-academic factors of poverty and poor student health. The focus of these question items seemed to be related to factors that were non-academic in nature and related to the external environment of the school itself and the actions of people other than students acting independently. We named this factor 'neighborhood context' (Brooks-Gunn, 1997; Crowder & South, 2003; Epstein et al., 2002; Harding, 2003; Leithwood & Riehl, 2003) to attempt to capture the underlying meaning of these different themes. This factor represents the extent to which an individual teacher perceives of non-student external factors affect the school environment.

We named the sixth within-level individual teacher factor 'teacher commitment' (Boyce & Bowers, in press) This decision was based on past SASS literature that used this term to describe teachers' attitudes and behaviours around their professional behaviour and likelihood of turnaround. One of the question items included in this factor specifically asks teachers if they would become a teacher again, which we identified as being related to teachers' professional commitment prior to performing our analysis. Other question items relate to teachers leaving for a higher paying job, thinking about staying home, and issues around stress, disappointment, and tiredness from teaching. Importantly, while one question item related to teacher satisfaction did has a significant loading on this factor, both it and the second question item related to teacher satisfaction both had strong loadings on the collegial climate factor. This suggests this factor does not describe teacher satisfaction, supporting our naming of teacher commitment. This factor represents how an individual teacher perceives of her professional fulfillment.

The six different within-level individual teacher factors all had significant correlations between them (see Table 2). The strongest correlations were between school influence and classroom control (0.561), school influence and collegial climate (0.567), collegial climate and teacher commitment (0.547), collegial climate and neighborhood context (0.458), and neighborhood context and student attendance (0.636). There were weaker correlations between school influence and neighborhood context (0.330), school influence and teacher commitment (0.369), classroom control and collegial climate (0.306), classroom control and teacher commitment (0.309), and neighborhood context and teacher commitment (0.372). The remaining correlations were below 0.300.

Figure 1: Factor structure of multilevel confirmatory factor analysis model

This is a visual representation of the information from Table 2. Circles represent the factors and rectangles represent indicators. All factors at both levels are correlated with all other factors at that level.



Boyce & Bowers (2018)

The first between-level collective teacher factor included the entire classroom control factor, the entire teacher commitment factor, and the question items from the school influence factor relating to teachers, curriculum, and performance standards for students. Additionally, it included a question item relating to school performance on state and/or local tests that did not load on any of the within-level factors (T0447). Given these loadings, we named this factor 'instructional leadership' (Hallinger & Murphy, 1985). The focus of the factor appears to be related to what happens in teachers' classrooms, instructional aspects of school-wide decision-making, and student performance. The inclusion of the within-level teacher commitment factor in this between-level factor suggests that teachers' professional commitment is very strongly related to the degree to which they are involved in the instructional leadership of their schools. This factor represents the extent to which the collective faculty of a school feels it can impact the core instructional program of its school. Based on Dyer et al.'s (2005) MLFA framework, this collective teacher factor is a compilation factor as there is no equivalent factor at the individual level. The instructional leadership factor is unique to the between-level factor structure.

The second between-level collective teacher factor included the entire collegial climate factor, the question items from the school influence factor relating to in-service professional development programs, discipline policy, and school budgeting, and one question item from teacher commitment for whether or not the stress and disappointments of teaching at one's school were worth it. Given these loadings, we named this factor 'management' (Murphy et al., 2006, 2007). The focus of the factor appears to be related to how the adults relate to one another and the non-instructional aspects of school-wide decision-making. This factor represents the extent to which the collective faculty of a school feels that it can impact the management of the school and the extent to which the school is well-managed. Based on Dyer et al.'s (2005) MLFA framework, this collective teacher factor is a compilation factor as there is no equivalent factor at the individual level. The management factor is unique to the between-level factor structure.

The third between-level collective teacher factor included the entire student attendance factor, the entire neighborhood context factor, and a question item relating to school performance on state and/or local tests that did not load on any of the within-level factors (T0447). The focus of the factor appears to be the union of students' behaviour and the behaviours of people external to schools who have high levels of influence on students. We combined these meanings in naming this factor 'social environment' (Epstein et al., 2002; Leithwood & Riehl, 2003; Paulsen, 1991; Ryan & Patrick, 2001; Trickett & Moos, 1973; Yen & Syme, 1999). This factor represents the extent to which the collective faculty of a school perceives of external factors in general affect the school environment. Based on Dyer et al.'s (2005) MLFA framework, this collective teacher factor is a compilation factor as there is no equivalent factor at the individual level. The social environment factor is unique to the between-level factor structure.

The three different between-level collective teacher factors all had significant correlations between them (see Table 2). The strongest correlation was between management and social environment (0.475). There were weaker correlations between instructional leadership and management (0.319) and instructional leadership and social environment (0.328).

DISCUSSION:

The present study represents the first study of the most recent administration of SASS to employ multilevel factor analysis with cross-validation in order to understand how teachers both individually and collectively perceive leadership for learning in their schools. We found six factors at the within level (individual teachers, also referred to as level 1): school influence, classroom control, collegial climate, student attendance, neighborhood context, and teacher commitment. We found three factors at the between level (teachers collectively, also referred to as level 2): instructional leadership, management, and social environment. This study demonstrates the strength of multilevel factor analysis in both accurately modeling how teachers within schools perceive leadership for learning and in providing significant insight into how individual teachers perceive their environments differently from how schools' faculties perceive their environments.

Dyer et al.'s (2005) multilevel factor typology is a useful lens to apply to help understand how individual teachers differ from teachers collectively. Dyer et al. (2005) posit that there are three different types of between-level factors: composition factors that are functionally the same at both the level of the individual teachers and the level of schools, compilation factors that are only meaningful at the level of a school's faculty, and fuzzy factors that are partially isomorphic between the individual and collective levels. Based on the results of our analysis, the level 2 collective teacher factors appear to all be compilation factors with no specific representation at the level 1 individual teacher level, as none of the school-level teacher collective factors have isomorphic relationships with factors at the individual teacher level (see Figure 1).

Our findings suggest that a school's faculty (operating at the between level, or the collective level) has represents a functional view of leadership for learning (Morgeson, DeRue, & Karam, 2009) in a way that is qualitatively different from how individual teachers conceive of leadership for learning. Teachers collectively see leadership for learning as relating to three different functions of a school: carrying out the instructional program of the school (instructional leadership factor), performing non-instructional tasks in support of the instructional program (management factor), and engaging with the larger

context of the school (social environment factor). This supports the conceptualization of educational leadership as an organizational function rather than a specific collection of tasks and activities (Gronn, 2002a, 2002b; Spillane et al., 2001, 2004). In contrast to this, individual teachers perceive of leadership for learning as being more related to specific areas of influence (Boyce & Bowers, in press; Everitt, 2005; Ni, 2012; Rosen, 2007; Skinner, 2008; Smith & Rowley 2005). Individual teachers are more aware of whether or not particular leadership tasks are being enacted (within classrooms or across entire schools) than they are aware of the specific function that the leadership task is fulfilling. Similarly, individual teachers have a more fine-grained awareness of the differences between contextual forces that impact student learning, namely seeing student attendance and neighborhood context as separate constructs rather than viewing them as a single interrelated construct.

These findings may speak to educational sociological theories around emergent properties (Jacobson & Wilensky, 2006; Lesh, 2006; Wilmott, 1999). The concept of emergent properties is that there are certain system-level functions and effects that can only be observed through the networked interaction of the actors within that system (Jacobson & Wilensky, 2006; Lesh, 2006; Wilmott, 1999). The lack of isomorphisms between the individual- and collective-level factors in our findings could be the result of the three collective factors being emergent properties of faculties in schools. This would speak to why there are no isomorphisms between the two levels and why individual teachers have an areas of influence view of leadership for learning while teachers collectively have a more functional view of leadership. Given that some school leadership functions occur at the level of the organization and not the level of the individual (Murphy et al., 2006, 2007; Spillane et al., 2001, 2004), it is possible that teachers engage with these leadership functions through emergent properties around their collective leadership function.

The present study highlights that one of the fundamental elements of the original instructional leadership framework (Hallinger & Murphy, 1985) still holds true in current conceptions of leadership for learning (Halverson & Dikkers, 2011; Kelley & Halverson, 2012; Murphy et al., 2006, 2007). Hallinger and Murphy (1985) put forth that instructional leadership was a superordinate function of the school relative to the teachers. In other words, instructional leadership was something that individual teachers did not enact, but something that was enacted above their organizational level. The present study supports this proposition by demonstrating that teachers collectively can perceive instructional leadership in a way that individual teachers cannot. This study also speaks directly to the relationship between instructional leadership (Hallinger & Murphy, 1985) and leadership for learning (Halverson & Dikkers, 2011; Kelley & Halverson, 2012; Murphy et al., 2006, 2007). Specifically, these findings are in alignment with past educational leadership research that suggests the instructional leadership framework is a subset of the larger leadership for learning framework (Boyce & Bowers, in press).

Beyond the existence of the factors themselves, the correlations between the factors speak directly to past leadership literature. At the individual level, one of the strongest correlations is between individual-level teacher school influence and collegial climate (0.567). This supports past findings of teachers' autonomy and influence within schools influencing the adult development of teachers more than other instructional leadership factors (Boyce & Bowers, in press; Cannata, 2007; Hunt, 2003; Weathers, 2011). The correlation between collegial climate and teacher commitment is similar (0.547), suggesting that the nature and quality of the interpersonal relationships between the adult members of the schools are important to each teachers' own intrapersonal relationships between herself and her job. This could tie into past literature regarding Leader-Member Exchange theory (LMX) and the body of LMX literature that has found powerful connections between interpersonal relationships, intrapersonal dispositions, organizational performance, and individual performance (Gerstner & Day, 1997; Graen, Novak, & Sommerkamp, 1982; Graen & Uhl-Bien, 1995; Wayne, Shore, & Liden, 1997).

This study also speaks to current educational leadership research related to the collective action of teachers in the form of professional learning communities (PLCs) (Hairon, Goh, & Chua, 2015; Murphy, 2015). PLCs have been shown to serve significant organizational roles within schools, such as allowing teachers to collectively enact instructional leadership tasks (Hairon et al., 2015). Additionally, research into PLCs has shown that they are structures that promote the development of positive, professional relationships and individual teacher learning (Hairon et al., 2015). The questions of how and why PLCs can effectively serve both organizational and individual roles with supporting and developing teacher leadership have been stymied by a lack of valid constructs that allow for deep and meaningful theoretical frameworks to be developed (Harion et al., 2015). The results of the present study directly inform this body of literature by providing empirical individual and aggregate teacher leadership factors.

Beyond providing a link between collective and individual teacher leadership, PLCs also provide a crucial link between principal leadership and teacher leadership (Murphy, 2015). Effective school leadership relies on having structures in place for the practice of collaborative leadership that includes both principals and teachers (Drago-Severson, 2004; Murphy, 2015). This is because principals serve complex dual roles in schools, existing as both the formal leaders of school communities while also being active members of the communities that they lead (Marks & Printy, 2003; Printy et al., 2009). This requires principals to lead by example through ways that direct the development of their teachers while simultaneously empowering teachers as leaders themselves (Drago-Severson, 2004; Murphy, 2015). Effective PLCs can serve as structures for principals and teachers to collaborate in ways that support both principal and

teacher leadership (Hairon et al., 2015; Murphy, 2015). The present study can inform leadership practice by providing a grounded understanding of how to structure PLCs. The collective teacher factors of instructional leadership, management, and social environment provide a grounding for how schools might structure the overarching functions and goals of PLCs and areas in which principals can directly model leadership behaviours in developing their teachers as leaders. Similarly, the individual teacher factors of school influence, classroom control, collegial climate, and student attendance might structure how the individual teachers carry out the collective leadership decisions made in PLCs as a communal effort that principals support without necessarily directly involving themselves.

There are important methodological implications that follow from our results in addition to the conceptual implications. Past educational leadership research has had methodological difficulties in correctly modeling nested data, leading to both empirical and methodological difficulties in addressing aggregate constructs in educational leadership (Boyce & Bowers, in press; Heck & Hallinger, 2014; Leithwood & Jantzi, 2008; Urick & Bowers, 2011, 2014b). This paper addresses these issues by providing the beginnings of a multilevel theory of different levels of leadership for learning (Chan, 1998; Chen, Bliese, & Mathieu, 2005; Dyer et al., 2005; Mumford, 1998) that is empirically grounded in a nationally generalizable dataset. This addresses past issues with empirically investigating different pathways of school leadership (Hallinger & Heck, 2011; Heck & Hallinger, 2009) by, for example, providing a starting point for future research employing multilevel structural equation modeling (Kline, 2010), a method well-suited to exploring the relationships and pathways of leadership for learning.

Another important methodological implication is with respect to factors in education research. Similarly to aggregating individual responses to the school level by simply averaging them together, some researchers employ measures that are intended to measure group-level constructs using individual-level factor analysis to justify the instrument (e.g., Goddard, Hoy & Hoy, 2000) (Chan, 1998; Chen, Bliese, & Mathieu, 2005; Dyer et al., 2005; Mumford, 1998). The present study demonstrates that these statistical findings may not be sufficient justification for using such measures. Specifically, a factor that holds together well at the individual level is not guaranteed to hold together well at the collective level (Chan, 1998; Chen, Bliese, & Mathieu, 2005; Dyer et al., 2005; Mumford, 1998). As discussed above, teachers' perceptions of their school influence is an example of an individual-level factor that has no analogue at the collective level. Given this, researchers who want to accurately measure collective constructs should be certain to employ appropriate multilevel modeling practices to determine whether or not particular factors of interest are being accurately modeled at the appropriate level.

Limitations

One potential limitation of the study is with our cluster size. In conducting our analysis, the between-level modeling was challenging, as evidenced by the number of between-level cross-loaded factors during stage two and the MCFA $SRMR_{between}$ statistics being above our desired threshold in stage four. These suggest that our statistical models may have had difficulty with accurately modeling between-level factors, which may be able to be improved through increased cluster size.

The second potential limitation of the present study is that the factor structure is constrained by the questions asked in the 2011–12 administration of SASS. The 2011–12 SASS was selected for this study because it asks teachers a wide-ranging collection of questions related to leadership for learning, of which we included 49 of the question items as indicators in our analytic model. That said, there are other datasets that ask different sets of questions that may provide different insights into teachers' perceptions. We encourage further research into teachers' perceptions of leadership for learning using different datasets to determine whether or not the factors we found in the present study are consistent across different measures.

A third potential limitation of the present study is the lack of principal perceptions included in our analysis. We attempted several times to include 2011–12 SASS principal perceptions in the present study, yet encountered several problems in attempting factor analysis on the principal data: some factors consistently did not have any strong loadings on any of their indicators, some factors had only one or two indicators, some models would not stabilize after even several rounds of trimming (i.e., after removing indicators that did not have any significant loadings the next round of models would have new indicators without any significant loadings, and so on), and the trimming process sometimes removed almost entire sections of the principal survey. We encourage further research along this line using other datasets that may be more amenable to principal and teacher comparative factor analysis, such as TALIS (OECD, 2014).

Conclusion

In conclusion, this study found that there are important differences in how individual teachers and teachers collective perceive of leadership for learning in their schools. Individual teachers viewed leadership for learning as being a combination of school influence, classroom control, collegial climate, student attendance, neighborhood context, and teacher commitment, whereas teachers collectively viewed leadership for learning as being a combination of instructional leadership, management, and social environment.

This study has strong implications for research, policy, and practice. For research, our results highlight the importance of using multilevel modeling techniques in understanding educational leadership. In particular, this study demonstrates that there are important conceptual differences between how individuals and groups perceive their environments. For policy,

this study highlights the difficulty in performing school-level interventions. As said succinctly by O'Day (2002, p. 295): 'The school is the unit of intervention, yet the individual is the unit of action.' There are differences and tensions between how to motivate the faculty of a school and how to motivate individual teachers in their classrooms (O'Day, 2002), which is in strong alignment with our findings regarding teacher commitment. Future policy initiatives and analyses need to account for the difference between how teachers and schools operate at the individual and collective levels. For practice, this study informs principals and other education leaders that effective school leadership must address the needs of both the individual adults in the schools and the adults as a collective body. Individual and collective sense-making processes have significant differences, both of which are important to attend to in running effective schools.

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Appendix A: Descriptive statistics, full analytic sample

SASS Question	Min	Max	*M*	*SD*	SASS Variable
School-level influence					
Setting student performance standards	0	1	0.57	0.50	T0420, 1 = high influence
Establishing curriculum	0	1	0.64	0.48	T0421, 1 = high influence
Determining in-service prof. dev.	0	1	0.45	0.50	T0422, 1 = high influence
Evaluating teachers	0	1	0.16	0.37	T0423, 1 = high influence
Hiring new full-time teachers	0	1	0.25	0.43	T0424, 1 = high influence
Setting discipline policy	0	1	0.42	0.49	T0425, 1 = high influence
Deciding budget spending	0	1	0.16	0.37	T0426, 1 = high influence
Classroom-level control					
Selecting textbooks, materials	0	1	0.64	0.48	T0427, 1 = high control
Selecting content, topics, skills	0	1	0.68	0.47	T0428, 1 = high control
Selecting teaching techniques	0	1	0.94	0.25	T0429, 1 = high control
Evaluating and grading students	0	1	0.95	0.22	T0430, 1 = high control
Disciplining students	0	1	0.88	0.32	T0431, 1 = high control
Determining amount of homework	0	1	0.94	0.23	T0432, 1 = high control
Agree or disagree with…					
Administration is supportive	0	1	0.84	0.36	T0435*, 1 = agree
Satisfied with salary	0	1	0.50	0.50	T0436*, 1 = agree
Student misbehavior interferes	0	1	0.60	0.49	T0437, 1 = disagree
Great deal of parent support	0	1	0.59	0.49	T0438*, 1 = agree
Necessary materials are available	0	1	0.81	0.39	T0439*, 1 = agree
Routine duties interfere	0	1	0.33	0.47	T0440, 1 = disagree
Principal enforces school rules	0	1	0.84	0.37	T0441*, 1 = agree
Rules for behavior are enforced	0	1	0.64	0.48	T0442*, 1 = agree
My colleagues share my beliefs	0	1	0.86	0.35	T0443*, 1 = agree
Principal knows school he/she wants	0	1	0.84	0.37	T0444*, 1 = agree
Great deal of cooperative effort	0	1	0.81	0.39	T0445*, 1 = agree
Staff members are recognized	0	1	0.74	0.44	T0446*, 1 = agree
Worry about job security	0	1	0.60	0.49	T0447, 1 = disagree
Standards have positive influence	0	1	0.47	0.50	T0448*, 1 = agree
Given the support needed to teach	0	1	0.68	0.47	T0449*, 1 = agree
Student tardiness/cutting interferes	0	1	0.61	0.49	T0450, 1 = disagree
Generally satisfied at this school	0	1	0.91	0.30	T0451*, 1 = agree
Conscious effort to coordinate	0	1	0.87	0.34	T0452*, 1 = agree
Extent of the following problems					
Student tardiness	0	1	0.57	0.50	T0455, 1 = small problem
Student absenteeism	0	1	0.50	0.50	T0456, 1 = small problem
Student class cutting	0	1	0.80	0.40	T0457, 1 = small problem
Teacher absenteeism	0	1	0.90	0.30	T0458, 1 = small problem
Students dropping out	0	1	0.84	0.36	T0459, 1 = small problem
Student apathy	0	1	0.48	0.50	T0460, 1 = small problem
Lack of parental involvement	0	1	0.42	0.49	T0461, 1 = small problem
Poverty	0	1	0.41	0.49	T0462, 1 = small problem
Students unprepared to learn	0	1	0.35	0.47	T0463, 1 = small problem
Poor student health	0	1	0.76	0.43	T0464, 1 = small problem
Agree or disagree with…					
Stress isn't worth it	0	1	0.79	0.40	T0465, 1 = disagree
Teachers like being here	0	1	0.77	0.42	T0466*, 1 = agree
Like the way things are run	0	1	0.74	0.44	T0467*, 1 = agree
I'd leave for a higher paying job	0	1	0.71	0.46	T0468, 1 = disagree
Think about transferring	0	1	0.70	0.46	T0469, 1 = disagree
Not as much enthusiasm	0	1	0.60	0.49	T0470, 1 = disagree
Think about staying home	0	1	0.80	0.40	T0471, 1 = disagree
Would become a teacher again	0	1	0.66	0.47	T0472*, 1 = high likelihood

Note: N = 34,850 teachers (unweighted). *M* and *SD* are unweighted. An asterisk (*) denotes a variable that was reverse-coded.

Appendix B: Intraclass correlation coefficients, exploratory subsamples

Variable	Exploratory Sample 1	Exploratory Sample 2	Exploratory Sample 3	Exploratory Sample 4
T0420: Performance standards	0.131	0.121	0.122	0.126
T0421: Curriculum	0.252	0.250	0.253	0.259
T0422: In-service PD	0.175	0.170	0.176	0.170
T0423: Evaluating	0.122	0.129	0.130	0.116
T0424: Hiring	0.316	0.319	0.321	0.314
T0425: Discipline	0.180	0.162	0.175	0.175
T0426: Budget	0.196	0.180	0.194	0.181
T0427: Textbooks	0.259	0.265	0.263	0.261
T0428: Content	0.214	0.211	0.215	0.214
T0429: Teaching	0.185	0.188	0.190	0.193
T0430: Grading	0.196	0.201	0.200	0.210
T0431: Discipline	0.133	0.143	0.147	0.137
T0432: Homework	0.300	0.328	0.333	0.337
T0435: Admin support	0.197	0.214	0.212	0.219
T0436: Salary satisfaction	0.237	0.240	0.229	0.240
T0437: Misbehavior	0.254	0.253	0.251	0.249
T0438: Parent support	0.204	0.205	0.214	0.205
T0439: Materials	0.211	0.215	0.213	0.225
T0440: Routine duties	0.093	0.079	0.078	0.087
T0441: Principal enforcement	0.242	0.248	0.243	0.241
T0442: Teacher enforcement	0.213	0.208	0.212	0.205
T0443: Shared beliefs	0.113	0.110	0.104	0.106
T0444: Principal knows	0.259	0.266	0.267	0.256
T0445: Cooperative effort	0.171	0.168	0.168	0.175
T0446: Recognition	0.187	0.199	0.182	0.196
T0447: Job security	0.168	0.172	0.179	0.169
T0448: Standards influence	0.065	0.066	0.071	0.065
T0449: Given support	0.098	0.103	0.098	0.101
T0450: Tardiness/cutting	0.259	0.259	0.261	0.260
T0451: Generally satisfied	0.177	0.172	0.161	0.185
T0452: Coordination	0.061	0.061	0.072	0.071
T0455: Tardiness	0.377	0.376	0.374	0.377
T0456: Absenteeism	0.383	0.368	0.386	0.374
T0457: Cutting	0.544	0.534	0.538	0.536
T0458: Teacher absenteeism	0.279	0.304	0.296	0.292
T0459: Dropping out	0.544	0.557	0.561	0.565
T0460: Student apathy	0.329	0.318	0.331	0.334
T0461: Parent involvement	0.434	0.439	0.442	0.437
T0462: Poverty	0.607	0.613	0.610	0.614
T0463: Unprepared to learn	0.413	0.430	0.418	0.423
T0464: Student Health	0.331	0.328	0.337	0.325
T0465: Stress	0.120	0.122	0.116	0.125
T0466: Like being here	0.295	0.285	0.286	0.294
T0467: Like how school is run	0.240	0.241	0.233	0.235
T0468: Leave for higher pay	0.089	0.084	0.080	0.091
T0469: Think of transfer	0.153	0.144	0.149	0.145
T0470: Less enthusiasm	0.064	0.055	0.061	0.072
T0471: Consider staying home	0.079	0.070	0.065	0.069
T0472: Become a teacher again	0.073	0.067	0.065	0.072

Appendix C: Multilevel exploratory factor analysis fit statistics

Panel A: Exploratory subsample 4, within-level MEFA fit statistics

# Factors	Chi-sq.	*df*	*p*-value	CFI	RMSEA	$SRMR_{within}$
1	94211.344	1127	<0.0001	0.532	0.056	0.115
2	53700.530	1079	<0.0001	0.736	0.043	0.083
3	36237.055	1032	<0.0001	0.823	0.036	0.065
4	24164.099	986	<0.0001	0.884	0.030	0.053
5	16588.899	941	<0.0001	0.921	0.025	0.043
6	**11924.798**	**897**	**<0.0001**	**0.945**	**0.022**	**0.034**
7	9735.244	854	<0.0001	0.955	0.020	0.030
8	Convergence issues					
9	Not reported given convergence issues with prior model					
10	Not reported given convergence issues with prior model					

Panel B: Exploratory subsample 4, between-level MEFA fit statistics

# Factors	Chi-sq.	*df*	*p*-value	CFI	RMSEA	$SRMR_{between}$
1	14469.391	1127	<0.0001	0.933	0.021	0.161
2	10010.971	1079	<0.0001	0.955	0.018	0.114
3	**4961.409**	**1032**	**<0.0001**	**0.980**	**0.012**	**0.074**
4	3749.693	986	<0.0001	0.986	0.010	0.063
5	3008.721	941	<0.0001	0.990	0.009	0.049
6	2054.363	897	<0.0001	0.994	0.007	0.041
7	1730.345	854	<0.0001	0.996	0.006	0.036
8	1438.596	812	<0.0001	0.997	0.005	0.032
9	1199.405	771	<0.0001	0.998	0.005	0.029

Note: The bolded rows represent the fit statistics for the final selection of stage two: six within-level factors and three between-level factors.

Appendix D: Multilevel exploratory factor analysis fit statistics, 6 within-level factors, 3 between-level factors

Exploratory Subsample	CFI	RMSEA	$SRMR_{within}$	$SRMR_{between}$
Initial model				
E. Sample 1	0.929	0.017	0.033	0.076
E. Sample 2	0.931	0.016	0.033	0.079
E. Sample 3	0.931	0.017	0.034	0.074
E. Sample 4	0.930	0.017	0.034	0.074
First trim				
E. Sample 1	0.931	0.018	0.033	0.073
E. Sample 2	0.932	0.018	0.033	0.077
E. Sample 3	0.933	0.018	0.033	0.073
E. Sample 4	0.932	0.018	0.033	0.073
Second trim				
E. Sample 1	0.934	0.019	0.032	0.073
E. Sample 2	0.936	0.019	0.032	0.078
E. Sample 3	0.936	0.019	0.032	0.073
E. Sample 4	0.936	0.019	0.032	0.073

Appendix E: Multilevel confirmatory factor analysis fit statistics

Confirmatory Subsample	CFI	RMSEA	$SRMR_{within}$	$SRMR_{between}$
Initial model				
C. Sample 1	0.832	0.027	0.078	0.148
C. Sample 2	0.831	0.027	0.076	0.145
C. Sample 3	0.832	0.027	0.078	0.148
C. Sample 4	0.836	0.028	0.081	0.156
Second model				
C. Sample 1	0.829	0.027	0.078	0.130
C. Sample 2	0.831	0.027	0.076	0.124
C. Sample 3	0.832	0.027	0.078	0.132
C. Sample 4	0.835	0.028	0.081	0.133
Third model				
C. Sample 1	0.829	0.027	0.078	0.129
C. Sample 2	0.832	0.027	0.076	0.121
C. Sample 3	0.831	0.027	0.078	0.132
C. Sample 4	0.835	0.028	0.081	0.130
Fourth model				
C. Sample 1	0.882	0.023	0.065	0.127
C. Sample 2	0.885	0.022	0.063	0.118
C. Sample 3	0.882	0.023	0.065	0.129
C. Sample 4	0.895	0.022	0.064	0.128

Appendix F: Mplus code for stage four final multilevel confirmatory factor analysis, 6 within-level factors, 3 between-level factors

```
TITLE:    Teacher Final MCFA, weighted by composite, Confirmatory Sample 4
          6 within-level factors, 3 between-level factors
          model trimmed of T0436 T0437 T0439 T0440 T0448 T0449 T0452
          model trimmed of T0431 T0458 T0469
DATA:      FILE =         N:\MLFA\Directory\File.dat ;
VARIABLE:  NAMES =        JNTLNUMS CNTLNUMS FILTER TFNLWGT SFNLWGT CFNLWGT
                          T0420 T0421 T0422 T0423 T0424 T0425 T0426 T0427
                          T0428 T0429 T0430 T0431 T0432 T0435 T0436 T0437
                          T0438 T0439 T0440 T0441 T0442 T0443 T0444 T0445
                          T0446 T0447 T0448 T0449 T0450 T0451 T0452 T0455
                          T0456 T0457 T0458 T0459 T0460 T0461 T0462 T0463
                          T0464 T0465 T0466 T0467 T0468 T0469 T0470 T0471
                          T0472 ;
           CLUSTER =      JNTLNUMS ;
           WEIGHT =       CFNLWGT ;
           CATEGORICAL =  T0420 T0421 T0422 T0423 T0424 T0425 T0426 T0427
                          T0428 T0429 T0430 T0432 T0435
                          T0438 T0441 T0442 T0443 T0444 T0445
                          T0446 T0447 T0450 T0451 T0455
                          T0456 T0457 T0459 T0460 T0461 T0462 T0463
                          T0464 T0465 T0466 T0467 T0468 T0470 T0471
                          T0472 ;
           USEVARIABLES = T0420 T0421 T0422 T0423 T0424 T0425 T0426 T0427
                          T0428 T0429 T0430 T0432 T0435
                          T0438 T0441 T0442 T0443 T0444 T0445
                          T0446 T0447 T0450 T0451 T0455
                          T0456 T0457 T0459 T0460 T0461 T0462 T0463
                          T0464 T0465 T0466 T0467 T0468 T0470 T0471
                          T0472 ;
ANALYSIS:  TYPE =         TWOLEVEL ;
           ESTIMATOR =    WLSMV ;
           PROCESSORS =   8 ;
           STARTS =       20 ;
           STITERATIONS = 15 ;
MODEL:     %WITHIN%
           w1 BY T0420 T0421 T0422 T0423 T0424 T0425 T0426 ;
           w2 BY T0421 T0427 T0428 T0429 T0430 T0432 ;
           w3 BY T0435 T0441 T0442 T0443 T0444 T0445 T0446 T0451 T0466 T0467;
           w4 BY T0450 T0455 T0456 T0457 ;
           w5 BY T0438 T0459 T0460 T0461 T0462 T0463 T0464 ;
           w6 BY T0451 T0465 T0468 T0470 T0471 T0472 ;
           %BETWEEN%
           b1 BY T0420 T0421 T0422 T0423 T0424 T0427 T0428 T0429 T0430 T0432
                 T0438 T0447 T0451 T0465 T0466 T0468 T0470 T0471 T0472 ;
           b2 BY T0420 T0422 T0423 T0425 T0426 T0435 T0441 T0442 T0443 T0444
                 T0445 T0446 T0451 T0465 T0466 T0467 ;
           b3 BY T0438 T0447 T0450 T0455 T0456 T0457 T0459 T0460 T0461 T0462
                 T0463 T0464 ;
OUTPUT:    STANDARDIZED ;
```