

Running head: THE DISTRIBUTED LEADERSHIP INVENTORY

Development and Validation of Scores on the Distributed Leadership Inventory

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Abstract

Systematic quantitative research on measuring distributed leadership is scarce. In this study, the Distributed Leadership Inventory (DLI) was developed and evaluated to investigate leadership team characteristics and distribution of leadership functions between formally designed leadership positions in large secondary schools. The DLI was presented to a sample of 2198 respondents in 46 secondary schools. The input from a first sub-sample was used to perform exploratory factor analyses; the second sub-sample was used to verify the factor structure via confirmatory factor analysis. A one-factor structure for the leadership team characteristics (coherent leadership team) and a two-factor structure for the leadership functions (support and supervision) were confirmed. The results of the DLI underpin that leading schools involve multiple individuals, which differs by the type of function.

Key words: distributed leadership, exploratory factor analysis, confirmatory factor analysis

Development and Validation of Scores on the Distributed Leadership Inventory

The significance of leadership in schools is widely accepted. Many researchers (e.g., Sammons, Hillman, & Mortimore, 1995; Scheerens, 1992) define school leadership as an important factor contributing to school effectiveness and school improvement. Also, Leithwood, Louis, Anderson, and Wahlstorm (2004) stated that the success of school reform depends on the motivation and capacities of the school leadership. However, due to the complexity of the current educational setting, the traditional 'single person' leadership paradigm is questioned (Goleman, 2002; Harris, 2004). Because leadership tasks have become increasingly complex, there is a tendency to move away from the heroic leadership style to an approach that stresses the distribution of leadership among the school team (Bush & Glover, 2003).

According to the distributed leadership literature, leadership is not regarded as an important characteristic of the individual school leader, but as a process shaped by the daily interactions between the school leader and the school organization (Spillane, Halverson, & Diamond, 2004). Especially in large schools, where principals can no longer develop their leadership through daily interactions with all other school members, leadership can be distributed across a number of other individuals (Firestone, 1996).

In this study we investigate the distribution of leadership among the principal, the assistant principals and teachers with a formal leadership role (i.e., teacher leaders) in large secondary schools. These people can play a major role in the way leadership is distributed throughout the school organization. According to Harris, Leithwood, Day, Sammons, and Hopkins (2007) distributed leadership is a potential contributor to positive change and transformation in school systems. Furthermore, they claimed that many schools are currently trialing alternative models of leadership to distribute leadership more widely. Although

distributed leadership is a valuable alternative for the dominant 'single person' leadership models, empirical research concerning distributed leadership is limited (Harris et al., 2007; Lashway, 2003; Spillane, 2006). Especially, quantitative research concerning the perceptions of distributed leadership in large secondary schools is needed.

In this article, we first examine the theoretical framework of distributed leadership. This theoretical base is the starting point for the development of a questionnaire: the Distributed Leadership Inventory (DLI). This questionnaire measures the perceived quality of the leadership and the extent to which leadership is distributed. Next, the validation and reliability of the scores from the Distributed Leadership Inventory are described. Finally, the results of the Distributed Leadership Inventory are presented in order to describe and analyze the perceptions of teachers, teacher leaders, assistant principals, and principals on distributed leadership in large secondary schools.

Theoretical Framework

Distributed Leadership and Leadership Team Characteristics

According to Gronn (2002) distributed leadership is an emergent property of a group or network of interacting individuals. Similarly, Spillane (2006) stated that leadership is stretched over a number of individuals and that leadership is accomplished through the daily interaction of multiple leaders. These leaders can have formal or informal leadership positions because leadership rests on a base of expertise rather than hierarchical authority (Bennett, Wise, Woods, & Harvey, 2003; Copland, 2003; Woods, Bennett, Harvey, & Wise, 2004). However, according to Leithwood and Jantzi (2000), there should be a considerable caution on the part of those who argue that everyone should become a leader. They stated that schools might benefit most from leadership of a small number of easily identified sources. Therefore, we limit our focus to formal leadership positions. In Flanders (Belgium), formal leadership positions are assigned to the principal and, in schools with more than 600 pupils, the assistant

principal(s). Most secondary schools also have teacher leaders or coordinators, who are members of the leadership team. These teacher leaders are teachers who are part-time or full-time free of teaching duties to take up a leadership role. This leadership role includes student counseling, instructional support or administrative tasks.

The leadership team, consisting of the principal, the assistant principals and teacher leaders, should have a clear management framework characterized by group cohesion (Bennett et al., 2003; McGarvey & Marriott, 1997), which refers to the openness of the team members, their mutual trust, communication and cooperation (Holtz, 2004), and unambiguous roles known and accepted by the members of the management team and the teachers (Chrispeels, Castillo, & Brown, 2000; Chrispeels & Martin, 2002; Grubb & Flessa, 2006; Harris, Muijs, & Crawford, 2003; Oswald, 1997; Sanders, 2006; Wise, 2001). Next, this leadership team should have a common sense of purpose and a consensus on the school goals (Bennett et al., 2003; Briggs & Wohlstetter, 2003; Grubb & Flessa, 2006; Leithwood, Steinbach, & Ryan, 1997; Macbeath, 2005; Neuman & Simmons, 2000).

Leadership Functions

For the study of distributed leadership, a line of research and theory is followed that conceptualizes leadership in terms of organizational functions and examines which members of the school typically charged with exercising leadership perform these functions (e.g., Camburn, Rowan, & Taylor, 2003; Heller & Firestone, 1995; Leithwood et al., 2007; Pounder, Ogawa, & Adams, 1995). In our study we selected three core functions of successful leaders mentioned in the instructional and transformational leadership models (Hallinger, 2003; Leithwood & Jantzi, 1999) and in the educational change literature (Heller & Firestone, 1995): (a) setting a vision, (b) developing people, and (c) supervising teachers' performance.

Setting a vision. Most of the theoretical models (e.g., Leithwood et al., 2004) considered setting directions and the development and articulation of a school vision as a

critical leadership function. However, setting a vision is no longer the monopoly of the school principals; other members in the school organization are challenged and empowered to take part in this leadership function (Barnett & McCormick, 2003; Bush & Glover, 2003; Smith & Piele, 1997).

Developing people. Leithwood et al. (2004) identified developing people as a second key function of successful leadership. Developing and stimulating teachers is a function that can easily be delegated by the principal to the lower management levels (Eden, 2001; Locke, 2003). Heller and Firestone (1995), for example, stated that teachers are well placed to provide colleagues with encouragement and recognition. They believed that this is much more difficult for central administrators by reason of distance.

Supervision. Complementary, we also included a key leadership function, which is mainly regarded as a function of formally designated leaders and is more difficult to distribute: the supervision of teachers' performance (Eden, 2001; Goldstein, 2003).

Empirical Studies

Research examining the effective measurement of shared or distributed leadership is scarce. Given the complexity and the youth of the field, it is not surprising that research on methods investigating distributed forms of leadership is lagging (Conger & Pearce, 2003). Moreover, most empirical studies have a qualitative research design (e.g., Crow & Pounder, 2000; Firestone & Martinez, 2007; Grubb & Flessa, 2006; Heller & Firestone, 1995; Maxcy & Nguyen, 2006; Moller & Eggen, 2005; Timperley, 2005).

According to Conger and Pearce (2003), three quantitative survey-based approaches to study distributed or shared leadership can be used. These three methods can involve the study of the group as (a) a whole, (b) a sum of its parts, and (c) a social network.

Group as a whole. The first approach uses items with the group as an entity as the source of influence and the group as a whole as the target of the influence. Examples of this

approach are the studies conducted by Avolio, Sivasubramaniam, Murry, Jung, and Garger (2003), Conley, Fauske and Pounder (2004), Gordon (2005), Wood (2005), and the questionnaire developed by Macbeath (2005). In these studies variables created at the group level of analysis are used. For example, Avolio et al. (2003) used the multi-factor leadership questionnaire (Avolio, Bass, & Jung, 1999) and participants were asked to judge how frequently their group or team as a whole displayed the behavior described in each statement. Conger and Pearce (2003) stated that the main strength of this approach is the nonburdensome data collection process. The main limit is that differences in contributions by individual members of the group are eliminated.

Group as a sum of its parts. The second approach of Conger and Pearce (2003) is the group as a sum of its parts. This approach uses items with each of the team members measured separately as the source of influence. An example of this second approach is the research of Silins, Mulford, and Zarins (2002), where respondents have to identify the leadership sources (e.g., principal, assistant principals, teacher leaders, teachers) in their school. The main strength of this approach is that it provides the ability to examine the influence of individuals to the overall leadership of the group. The primary limitation, according to Conger and Pearce (2003), is that this approach requires a great deal of effort from research participants as they must respond to the same item multiple times. This can result in problems associated with respondent fatigue.

Group as a social network. The third approach, the 'group as a social network', uses items that measure each of the individuals as the sources of influence and each of the individuals as the targets of influence. The group level variable is the degree to which leadership functions are centralized, or dispersed and shared across the group members. Conger and Pearce (2003) believed that due to this approach the degree to which all members are involved in the leadership of the team, the extent of dispersion of leadership in the team,

or the pattern of interaction can be investigated. The main limitation is the complexity of this method. This third approach has been advocated by Mayo, Meindl, and Pastor (2003). In this study of Mayo et al. (2003) all respondents have to indicate how often each team member is involved in a leadership function. The data are then represented in a sociogram, with points representing team members and links representing leadership relations. Based on this sociogram, Mayo et al. (2003) make conclusions concerning the decentralization of the team.

Conger and Pearce (2003) stated that more research that compares and contrasts the three quantitative methods to measure distributed leadership is needed to determine the efficacy of each method. Therefore, we will use the three approaches suggested by Conger and Pearce (2003) and integrate them in one instrument to measure distributed leadership.

Purpose

A major challenge is the assessment of distributed leadership. Therefore, the first aim of the present study is to develop and evaluate the Distributed Leadership Inventory. This research instrument captures senior and middle managers', and teachers' perceptions concerning the perceived quality of the leadership and the extent to which leadership functions are distributed among formally designated leadership positions. The second aim of this study is the description and analysis of distributed leadership in large secondary schools in Flanders (Belgium), based on the methodological recommendations of Conger and Pearce (2003).

Methods

Data Sources

Building on the theoretical framework of the study, we distinguished two main parts in the Distributed Leadership Inventory. The first part focused on the leadership functions of the members of the leadership team; the second part focused on the characteristics of the leadership team. Furthermore, demographical (e.g., years of experience, age, gender), and

school variables (e.g., school size, changes in the management structure during the last five years) were collected via specific questionnaire items.

Leadership functions. First, we asked the respondents to rate the individual leadership functions of the principal, the assistant principals, and the teacher leaders. For each subgroup the items were rated on a five-point Likert scale (never/0 to always/4). The scales that were used in the questionnaire were based on: strength of the vision (De Maeyer, Rymenans, Van Petegem, van den Bergh, & Rijlaarsdam, 2007), supportive leadership behavior (Hoy & Tarter, 1997), providing instructional support, and providing intellectual stimulation (Leithwood & Jantzi, 1999). For supervision we developed a scale based on the literature concerning supervising and monitoring teachers (e.g., Blase & Blase, 2002; Hallinger, 2003; Southworth, 2002).

Leadership team characteristics. Second, we asked the respondents about the characteristics of school leaders as a team. We used the subscales role ambiguity (Rizzo, House, & Lirtzman, 1970), group cohesion (Litwin & Stringer, 1968), and the degree of goal consensus (Staessens, 1990). A scale was developed for the expertise of the leadership team. The items were rated on five-point Likert scales (strongly disagree/0 to strongly agree/4). The wording of the scales mapping the leadership team characteristics differed slightly according to the subgroup respondents (e.g., “I” in the questionnaires for members of the leadership team versus “members of the management team” in the teacher questionnaires).

Subsequently, an initial interview with the principal of the selected schools occurred. In this interview we provided an explanation on the purpose of the research and requested basic information about the school and the management structure. Participating respondents were assured that their responses would be kept confidential through a covering letter. Also, the general aim of the study, which was to investigate the distribution of leadership in large secondary schools, was described in the covering letter.

Pilot Study

A first version of the Distributed Leadership Inventory was reviewed by 16 stakeholders (e.g., teachers, teacher leaders, principals, and policy makers) and tested in two pilot schools. These reviews focused mainly on the item complexity and the feasibility of the questionnaire. The reviews resulted in a refinement of the instrument (e.g., the possibility to make written remarks) and minor wording changes.

Sample

The Distributed Leadership Inventory was presented to 46 secondary schools with minimum 600 pupils in Flanders (Belgium), because these schools can appoint an assistant principal. The presence of minimal two senior managers provides opportunities for distributed leadership. The schools were selected from a list of 360 schools, provided by the Flemish Ministry of Education by using a stratified random sampling. Furthermore, the geographic regions (i.e., the five districts of Flanders) and the educational network (i.e., community, subsidized private, subsidized) were taken into account. The questionnaires were handed to all senior managers (i.e., principal and assistant principals), middle managers (i.e., teacher leaders or coordinators), and teachers of the second grade (14-16 year old pupils). A total of 2198 respondents, representing a response rate of 69 %, completed the questionnaire. 296 respondents had more than 10% missing data and were removed from the analysis.

Questionnaire data were analyzed from a sample of 1522 second grade teachers, 248 teacher leaders, 85 assistant principals, and 47 principals. The sample included 54.5 % female and 45.5 % male respondents. The age of the respondents ranged from 22 to 65, with an average of 41. The mean length in the current job was 12.7 years, varying from 0.1 to 40 years. In Table 1 the demographic variables are represented for the four subgroups of respondents.

<< INSERT TABLE 1 AROUND HERE >>

Analysis

In order to develop and evaluate the Distributed Leadership Inventory we conducted factor analyses. First, exploratory factor analyses (principal axis factoring) using SPSS were carried out on the results of a first stratified randomly selected sub-sample consisting of the four subgroups of respondents ($n = 951$), to identify clusters in the scales concerning the leadership team characteristics and leadership functions. Second, confirmatory factor analyses using AMOS were conducted on the data of the second stratified randomly selected sub-sample ($n = 951$) to examine the stability of the exploratory factor structure. Next, the results of the confirmatory factor analyses were re-examined on the data of the first sub-sample. Lastly, the reliability of the scores of the final version of the Distributed Leadership Inventory was determined.

In order to describe and analyze distributed leadership in large secondary schools in Flanders (Belgium), two variables (i.e., average leadership and maximum leadership) were designed to measure the perceived quality of the leadership in the schools. A third variable, leadership distribution, was constructed to examine the extent to which leadership is distributed. The three variables are based on methodological recommendations of Conger and Pearce (2003).

Group as a whole: average leadership. For the assessment of the group as a whole, variables created at the group level of analysis can be used. However, we attempted to integrate the three approaches to assess distributed leadership in one instrument. Using both items concerning the leadership team as a whole and items concerning the different members of the leadership team would be too burdensome. Therefore, we opted for the behavioral average options of the leadership members, which is the mean score of the principal, the assistant principals and the teacher leaders' scores. According to Conger and Pearce (2003) this approach is similar to the approach that uses general items concerning the leadership team

as an entity. The variable was labeled as *average leadership*, with a range from 0 (never) to 4 (always).

Group as a sum of its parts: maximum leadership. For the group as a sum of its parts, the dominant member option, or the scores of the highest rated individual (i.e., principal, assistant principals or teacher leaders) were used. We labeled this variable as *maximum leadership*. The maximum leadership varied from 0 (never) to 4 (always).

Group as a social network: leadership distribution. For the group as a social network, we assessed the centralization of the leadership team. This variable refers to the degree to which leadership functions were equally distributed across members of the leadership team, without taking into account the amount of the performed leadership function. We labeled this as *leadership distribution*, with a range from 0 to 6. The lowest score stands for centralization; the highest score stands for equal distribution among the principal, the assistant principals, and the teacher leaders.

In order to describe and analyze the three scores for distributed leadership and the leadership team characteristics, descriptive statistics and Pearson's correlation were used.

Results

Exploratory Factor Analyses

The results of a first stratified random sub-sample ($n = 951$) were used to carry out exploratory factor analyses, which helped to identify a number of latent factors to cluster (a) leadership team characteristics, and (b) leadership functions. For the latter, we conducted three exploratory factor analyses, respectively for the items concerning the leadership functions of the school principal, the assistant principals, and the teacher leaders. Principal axis factoring with promax rotation ($kappa = 4$) was adopted, because no orthogonality across components was assumed (Pohlmann, 2004). In order to extract the number of latent factors the eigenvalues larger than 1 (Kaiser-Guttman criterion – K1) are often reported. However,

the K1-rule is likely to over- or underestimate the number of factors in a data set. Therefore, in order to extract the number of factors we employed parallel analysis in R, with the 95th percentile as the comparison baseline, and the number of random data sets was 10,000 (Henson & Roberts, 2006; Horn, 1965; Pohlmann, 2004; Thompson & Daniel, 1996).

To interpret the factors we opted for factor loadings larger than .60. Because the original instrument had many items and we wanted a pure measure of the factors, we retained strong factor loadings.

Exploratory factor analysis of the leadership team characteristics. The first exploratory factor analysis was conducted on the items corresponding to the characteristics of the leadership team. The actual eigenvalues of the first four factors were 8.19, 1.12, 0.94, and 0.77; the random eigenvalues were 1.28, 1.22, 1.18, and 1.15. Based on the parallel analysis one factor should be retained. This one-factor structure accounted for 44.93% of the common variance and revealed one clearly defined factor: coherent leadership team.

Exploratory factor analysis of the leadership functions. The second exploratory factor analysis was conducted on the leadership functions. The first four actual eigenvalues of the leadership functions of the three subgroups of the leadership team were 17.35, 1.50, 1.31, and 1.21(principal); 17.41, 2.18, 1.25, and 1.05 (assistant principals); 15.55, 2.93, 1.40, and 0.96 (teacher leaders). The first random eigenvalues were 1.42, 1.37, 1.33, and 1.29. The parallel analyses suggested a two-factor solution for the school principal and the assistant principals, and a three-factor structure for the teacher leaders. Because we aimed at discovering a factor structure, which is applicable for the items concerning the principal, the assistant principals, and the teacher leaders, we looked for strong factor loadings ($> .60$) for the items concerning the three subgroups of the leadership team on two factors. Factor one consisted of items corresponding to setting a school vision and developing and empowering teachers, therefore we labeled this factor as *support*. Factor two was labeled as *supervision*. The two-factor

models explained 53.88% of the variance for the leadership functions of the principal, 55.95% of the variance for the leadership functions of the assistant principals, and 52.81% of the variance for the leadership functions of the teacher leaders.

Confirmatory Factor Analyses

First, confirmatory factor analyses, based on the data from the second sub-sample ($n = 951$), were conducted to study the stability of the exploratory factor structure. Confirmatory factor analyses were carried out to confirm the underlying one-component structure of the characteristics of the leadership team, and the two-component structures for the leadership functions of respectively the principal, the assistant principals, and the teacher leaders.

Second, the results of these confirmatory factor analyses were re-examined on the data of the first sub-sample, to assure that the modified models fitted for both samples of respondents.

In evaluating the model fit, we supplement the model chi-square statistic with both absolute and incremental fit indices (Bentler & Bonett, 1980; Bollen, 1989; Hu & Bentler, 1998, 1999; Kline, 1998; Schreiber, Nora, Stage, Barlow, & King, 2006). Absolute fit indices evaluate how well an a priori model reproduces the sample data. We report the root mean square error of approximation (RMSEA) for which a value less than 0.06 indicates a good model fit (Hu & Bentler, 1999), and a value less than 0.08 suggests a reasonable model fit (Browne & Cudeck, 1992; Schreiber et al., 2006). Also the standardized root mean square residual (SRMR) is reported for which a value of 0.08 or lower indicates a good fit (Hu & Bentler, 1999). Incremental fit indexes evaluate model fit by comparing a target model to a baseline model. Typically, the null model in which all observed variables are uncorrelated is used as a baseline model. We report the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the goodness-of-fit index (GFI), which have cut off values close to 0.90 (Kline, 1998) or 0.95 (Hu & Bentler, 1999). After examination of parameter estimates, fit indexes,

and residuals, model modifications are conducted to the original hypothesized model to have better fitting or a more parsimonious model (Schreiber et al., 2006).

Confirmatory factor analyses of the leadership team characteristics. The stability of the one-factor model of the coherent leadership team revealed moderate model fit results [$\chi^2 = 551.483$ ($df = 65$; $p < .001$), GFI = 0.909, CFI = 0.928, TLI = 0.914, SRMR = 0.048, RMSEA = 0.089 with a 90% interval of 0.082 and 0.096]. Inspection of the modification indices suggested high error covariance with the pairing of item goal consensus 3 and goal consensus 4 (respectively: all members of the leadership team work in the same strain on the school's core objectives; all members of the leadership team have the same vision), and role ambiguity 4 and role ambiguity 7 (respectively: members of the leadership team know exactly what is expected of them; members of the leadership team know which tasks they have to perform). The item wordings of these pairs of items were similar and it is plausible that their error terms were correlated. Cohesion 4 (i.e., members of the leadership team don't really trust each other – reversed item) had a weak correlation with the factor 'coherent leadership team', which can be explained by the reversion of the item. Removing goal consensus 4, role ambiguity 4, and cohesion 4 from the model revealed satisfactory model fit results [$\chi^2 = 138.098$ ($df = 35$; $p < .001$), GFI = 0.970, CFI = 0.978, TLI = 0.972, SRMR = 0.026, RMSEA = 0.056 with a 90% interval of 0.046 and 0.066]. This modified model was re-tested on the data of the first sub-sample and also revealed a good model fit [$\chi^2 = 156.498$ ($df = 35$; $p < .001$), GFI = 0.965, CFI = 0.975, TLI = 0.968, SRMR = 0.028, RMSEA = 0.060 with a 90% interval of 0.051 and 0.070]. The standardized parameter estimates had a range from .81 to .62 for the first sub-sample, and .80 to .61 for the second sub-sample.

Confirmatory factor analyses of the leadership functions. A first test of the two-factor model for the leadership functions performed by the principal revealed poor model fit results [$\chi^2 = 1331.094$ ($df = 151$, $p < .001$), GFI = 0.856, CFI = 0.902, TLI = 0.889, SRMR = 0.049,

RMSEA = 0.091 with a 90% interval of 0.086 and 0.095]. Also the model for the assistant principals and the teacher leaders were not confirmed [respectively $\chi^2 = 1259.110$ ($df = 151$, $p < .001$), GFI = 0.863, CFI = 0.903, TLI = 0.890, SRMR = 0.052, RMSEA = 0.088 with a 90% interval of 0.083 and 0.092, and $\chi^2 = 1242.748$ ($df = 151$, $p < .001$), GFI = 0.862, CFI = 0.885, TLI = 0.870, SRMR = 0.055, RMSEA = 0.087 with a 90% interval of 0.083 and 0.092].

Based on the high modification indices, which could be explained by the content similarity in pairs of items, a reduction of items was executed in a systematic way, starting with the highest indices of the models for the principal, the assistant principals, and the teacher leaders.

Goodness-of-fit indices were examined at each step in the process for the three models. This reduced the item set from 19 to 13 items. The changes resulted in a modified model that revealed satisfactory model fit results for the leadership functions of the principal [$\chi^2 = 353.840$ ($df = 64$; $p < .001$), GFI = 0.946, CFI = 0.960, TLI = 0.952, SRMR = 0.042, RMSEA = 0.069 with a 90% interval of 0.062 and 0.076], the assistant principals [$\chi^2 = 361.794$ ($df = 64$; $p < .001$), GFI = 0.944, CFI = 0.957, TLI = 0.948, SRMR = 0.047, RMSEA = 0.070 with a 90% interval of 0.063 and 0.077], and the teacher leaders [$\chi^2 = 390.001$ ($df = 64$; $p < .001$), GFI = 0.942, CFI = 0.943, TLI = 0.931, SRMR = 0.044, RMSEA = 0.073 with a 90% interval of 0.066 and 0.080].

Correlations between the two latent factors were statistically significant (principal: $r = 0.75$; assistant principals: $r = 0.64$; teacher leaders: $r = 0.55$). Therefore, one-factor structures were analyzed. However, tests of these one-factor models revealed poor model fit results [principal: $\chi^2 = 731.157$ ($df = 65$; $p < .001$), GFI = 0.885, CFI = 0.909, TLI = 0.891, SRMR = 0.053, RMSEA = 0.104 with a 90% interval of 0.097 and 0.111; assistant principals: $\chi^2 = 915.574$ ($df = 65$; $p < .001$), GFI = 0.858, CFI = 0.877, TLI = 0.852, SRMR = 0.068, RMSEA = 0.117 with a 90% interval of 0.111 and 0.124; teacher leaders: $\chi^2 = 941.670$ ($df = 65$; $p < .001$), GFI = 0.850, CFI = 0.848, TLI = 0.817, SRMR = 0.079, RMSEA = 0.119 with a 90%

interval of 0.112 and 0.126]. These results suggested that a two-factor structure of the leadership functions fitted better than a one-factor structure.

The modified two-component models were re-examined on the data of the first sub-sample and revealed satisfactory model fit [principal: $\chi^2 = 383.026$ ($df = 64$; $p < .001$), GFI = 0.942, CFI = 0.957, TLI = 0.947, SRMR = 0.046, RMSEA = 0.072 with a 90% interval of 0.066 and 0.080; assistant principals: $\chi^2 = 366.121$ ($df = 64$; $p < .001$), GFI = 0.945, CFI = 0.961, TLI = 0.952, SRMR = 0.049, RMSEA = 0.070 with a 90% interval of 0.064 and 0.078; teacher leaders: $\chi^2 = 353.205$ ($df = 64$; $p < .001$), GFI = 0.947, CFI = 0.953, TLI = 0.943, SRMR = 0.040, RMSEA = 0.069 with a 90% interval of 0.062 and 0.076]. The standardized parameter estimates (pattern coefficients) as well as structure coefficients (r_s) for the first sub-sample are presented in Table 2. Coefficients for the other sub-sample were quite similar in magnitude and pattern.

<< INSERT TABLE 2 AROUND HERE >>

Reliability of the Distributed Leadership Inventory Scores

The designed Distributed Leadership Inventory is presented in Table 3. The reliability of the scores of the Distributed Leadership Inventory was determined by using Cronbach's α coefficient (cf. Table 4). Confidence intervals (95%) were also evaluated using the method recommended by Fan and Thompson (2001). According to Henson (2001), Loo (2001), and Nunnally and Bernstein (1994), test scores should have reliabilities of .80 or better. We can conclude that the scores of the coherent leadership team had a high internal consistency in this sample ($\alpha = .91$). Also, the internal consistencies of the support scores were high, varying from .91 for the items concerning the teacher leaders to .93 for the items concerning the principal and the assistant principals. The scores of the supervision scales had acceptable reliability coefficients: $\alpha = .85$ (assistant principals), $\alpha = .83$ (principal) and $\alpha = .79$ (teacher leaders).

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The Description and Analysis of Distributed Leadership

In the next part results concerning the perceptions of the leadership functions of the principal, the assistant principals and the teacher leaders are presented. Also, the three approaches of distributed leadership and the coherent leadership team are discussed.

Table 5 shows that support was perceived as a leadership function of the principal ($M = 2.66$, $SD = 0.86$), the assistant principals ($M = 2.53$, $SD = 0.86$), and the teacher leaders ($M = 2.34$, $SD = 0.84$). Supervision was mostly performed by the principal ($M = 2.70$, $SD = 1.06$) and to a lesser extent by the assistant principals ($M = 2.19$, $SD = 1.16$) and the teacher leaders ($M = 1.38$, $SD = 1.08$). The average leadership variables, or the mean scores of the leadership functions of the principal, assistant principals and teacher leaders, varied from 2.09 ($SD = 0.82$) for supervision to 2.51 ($SD = 0.71$) for support. The maximum leadership, or the highest rated scores for the principal, assistant principals or teacher leaders, was 2.93 ($SD = 0.89$) for the supervisory leadership function, and 2.98 ($SD = 0.65$) for the supportive leadership function. The leadership distribution variables showed that leadership fairly bended to equally distributed forms of leadership (support: $M = 5.15$, $SD = 0.74$; supervision: $M = 4.32$, $SD = 1.16$). These results suggested that support was more equally distributed among the leadership team than supervision. For the characteristics of the leadership team we can conclude that leadership teams were moderately perceived as coherent ($M = 2.74$, $SD = 0.65$).

Finally, the correlations between the three approaches to measure distributed leadership and the coherent leadership team were examined. Table 5 reveals that the average leadership and the maximum score for the supportive leadership function ($r = 0.86$) and the supervisory leadership function ($r = 0.73$) were highly correlated. Also, the correlation between the average leadership and the leadership distribution for the two leadership

functions was high (r support = 0.60; r supervision = 0.63). This was not the case for the maximum leadership and the leadership distribution. This correlation was weak (r support = 0.17; r supervision = 0.03). Furthermore, there were moderate to high correlations between coherent leadership team and the three variables for the distribution of supportive leadership [$r = 0.67$ (average leadership), $r = 0.59$ (maximum leadership), $r = 0.40$ (leadership distribution)]. The correlations between coherent leadership team and the supervision variables were moderate to weak [$r = 0.35$ (average leadership), $r = 0.41$ (maximum leadership), $r = 0.08$ (leadership distribution)].

<< INSERT TABLE 5 AROUND HERE >>

Discussion and Conclusion

The Distributed Leadership Inventory (DLI) was developed based on a perceived need for a quantitative tool to assess distributed leadership in large secondary schools. The characteristics of the leadership team and the distribution of leadership functions among principals, assistant principals, and teacher leaders were taken into account. Based on the results of exploratory and confirmatory factor analyses, the two main parts of the DLI were explored. The leadership team characteristics resulted in a one-component model: coherent leadership team. For the leadership functions we aimed at developing an instrument that is applicable for the leadership functions performed by the principal, the assistant principals, and the teacher leaders. We expected, based on the initial theoretical framework, a three-component model (i.e., setting a vision, developing people, and supervision of teachers). This three-component model could not be revealed. Instead, a two-component model (i.e., support, and supervision) was confirmed, wherein the support variable consisted of items pertaining to both setting a vision and developing people. In other words, setting a vision and developing people can be distinguished in one component (i.e., support); but they could not be separated in two components. This is in line with previous research concerning transformational and

instructional leadership. Setting a vision and developing people are related to transformational leadership, because transformational leaders motivate and stimulate followers to transcend their own immediate self-interest for the sake of the mission or vision of the school (Burns, 1978). Transformational leaders recognize the need of followers and they attempt to elevate those needs from lower to higher levels of development and maturity (Bass, 1985; Leithwood & Jantzi, 1999; Nguni, Slegers, & Denessen, 2007). Supervising teachers pertains more to instructional leadership, which focuses predominantly on the role of the principal in directing, controlling and supervising in the school (Bamburg & Andrews, 1990; Hallinger, 2003; Hallinger & Murphy, 1985). Research has determined that effective leadership requires both leadership styles (Hallinger, 2003).

For the leadership functions performed by the teacher leaders parallel analyses suggested a three-factor structure. However, we opted for a two-factor model, consisting of support and supervision, analogous to the models of the principal, and the assistant principals. It is conceptually and empirically useful to distinguish between both dimensions in order to make comparisons between the leadership functions of the principal, the assistant principals and teacher leaders.

The scores on the DLI revealed internal-consistency reliability estimates larger than 0.79. In conclusion, we consider it to be a contribution to the research field that an adequate questionnaire was developed and examined to investigate distributed leadership in schools.

However, the DLI has some limitations, which should be addressed in future research. A first problem of our questionnaire was the amount of items. In particular, the reiteration of each item for the principal, the assistant principals, and the teacher leaders resulted in a high number of missing data. Due to the exploratory and confirmatory factor analyses an extensive item reduction occurred, which could have a positive impact on the amount of missing data. A second limitation of our study was the narrow focus on the distribution of leadership functions

among school members typically charged with exercising leadership. Future research should be expanded to broader leadership functions and include informal leadership exercised by individuals who are not in formally designated leadership positions. Third, in order to develop the research instrument we randomly divided the original research sample in two sub-samples. Hence, these two sub-samples were not truly independent samples. In future research the modified model needs to be validated in an independent sample. Furthermore, we would like to remark that the DLI should be amplified with qualitative research methods (e.g., interviews, observations, logbooks), which could lead to a broader view on the distribution of leadership. We want to stress that we developed a context-sensitive instrument for distributed leadership among formally designated leadership positions in large secondary schools. In addition, the appropriateness of the DLI should be assessed in a wider variety of contexts. Further refinement and evaluation of the DLI at other educational levels, and an evaluation across international educational contexts is needed. Finally, additional concurrent validity evidence is needed before the instrument is used too heavily.

Based on the results of the leadership functions, three approaches to investigate distributed leadership were developed: (a) average leadership, or the mean score for the principal, the assistant principals and teacher leaders on the leadership functions; (b) maximum leadership, or the score for the highest rated individual; (c) the leadership distribution, or the score for the equal distribution of the leadership functions among the principal, the assistant principals and the teacher leaders. These three scores correspond to three approaches appointed by Conger and Pearce (2003), who encouraged research comparing and contrasting these approaches. The results in this study revealed very high correlations between the average leadership and the maximum leadership. Therefore, we recommend future researchers examining distributed leadership, not to calculate all three

scores. Instead, future researchers should opt for the average or the maximum leadership, and the distribution of leadership.

Furthermore, the study offered preliminary evidence that leadership is not the solely domain of one person. Leadership is distributed among formal members of the leadership team (i.e., principals, assistant principals and teacher leaders), which is perceived as coherent. The results of our study confirm previous research (e.g., Spillane and Camburn, 2006): the work of leading and managing in schools involves multiple individuals and differs by the type of activity or function. Support is a leadership function highly distributed; supervision remains mainly a centralized function reserved for one person of the leadership team: the principal.

Distributed leadership has become a buzzword in the educational management research. However, empirical research investigating distributed leadership, and the possible implications of this leadership is limited. Future use of the DLI is envisioned to explore more in-depth the different approaches to measure distributed leadership, and its determinants. Moreover, the DLI can be used to investigate the effect of distributed leadership on organizational outcomes, like the organizational commitment or the job satisfaction of the members of the leadership team and the teachers, or the students' performance or wellbeing. Harris et al. (2007) have stressed the need for research that analyzes the impact of distributed leadership on the school organization. With the DLI, we believe we have developed an instrument that can be used in further research on school improvement and organizational outcomes.

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Tables and Figures

Table 1

Sample Description

	Principal (<i>n</i> = 47)	Assistant principal (<i>n</i> = 85)	Teacher leader (<i>n</i> = 248)	Teacher (<i>n</i> = 1522)	Total (<i>n</i> = 1902)
Gender in %					
Male	70.2%	72.9%	53.3%	41.9%	45.5%
Female	29.8%	27.1%	46.7%	58.1%	54.5%
Age					
Mean (min-max)	51.4 (34-63)	49.8 (28-64)	45.6 (26-62)	38.9 (22-65)	40.6 (22-65)
<i>SD</i>	5.7	6.6	8.4	10.7	10.7
Years of job experience					
Mean (min-max)	9.7 (0.5-29)	6.0 (0.5-38)	8.9 (0.1-39)	13.7 (0.1-40)	12.7 (0.1-40)
<i>SD</i>	6.5	5.6	7.7	10.6	10.3

Table 2

*Standardized Parameter Estimates for the Two-Factor Model of the Leadership Functions**(sub-sample 1, n = 951)*

Item	Pattern coefficients (Structure coefficients r_s)					
	Principal		Assistant principals		Teacher leaders	
	Support	Supervision	Support	Supervision	Support	Supervision
Vision 3	.66 (.66)	0 (.46)	.69 (.69)	0 (.41)	.65 (.65)	0 (.36)
Vision 6	.76 (.76)	0 (.53)	.77 (.77)	0 (.45)	.70 (.70)	0 (.39)
Supportive behavior 2	.82 (.82)	0 (.57)	.83 (.83)	0 (.49)	.75 (.75)	0 (.42)
Supportive behavior 3	.77 (.77)	0 (.54)	.78 (.78)	0 (.46)	.74 (.74)	0 (.41)
Supportive behavior 4	.81 (.81)	0 (.56)	.78 (.78)	0 (.46)	.73 (.73)	0 (.40)
Supportive behavior 5	.62 (.62)	0 (.44)	.62 (.62)	0 (.36)	.69 (.69)	0 (.38)
Supportive behavior7	.77 (.77)	0 (.54)	.78 (.78)	0 (.46)	.72 (.72)	0 (.40)
Providing intellectual stimulation 2	.79 (.79)	0 (.55)	.80 (.80)	0 (.47)	.78 (.78)	0 (.43)
Providing intellectual stimulation 5	.75 (.75)	0 (.53)	.81 (.81)	0 (.47)	.78 (.78)	0 (.43)
Providing instructional support 1	.74 (.74)	0 (.52)	.76 (.76)	0 (.47)	.72 (.72)	0 (.40)
Supervision 3	0	.72	0	.75	0	.78

	(.51)	(.72)	(.44)	(.75)	(.43)	(.78)
Supervision 4	0	.84	0	.85	0	.72
	(.59)	(.84)	(.50)	(.85)	(.40)	(.72)
Supervision 2	0	.79	0	.82	0	.72
	(.55)	(.79)	(.48)	(.82)	(.40)	(.72)
Correlations latent factors	$r = .70$		$r = .59$		$r = .55$	

Note: structure coefficients in parentheses

Table 3

Distributed Leadership Inventory

Scale	Item
	To what amount is (1) the principal, (2) the assistant principal(s), (3) the teacher leader(s) involved in the following statements?
Support	<p>... premises a long term vision</p> <p>... debates the school vision</p> <p>... compliments teachers</p> <p>... helps teachers</p> <p>... explains his / her reason for criticism to teachers</p> <p>... is available after school to help teachers when assistance is needed</p> <p>... looks out for the personal welfare of teachers</p> <p>... encourages me to pursue my own goals for professional learning</p> <p>... encourages me to try new practices consistent with my own interests</p> <p>... provides organizational support for teacher interaction</p>
Supervision	<p>... evaluates the performance of the staff</p> <p>... is involved in summative evaluation of teachers</p> <p>... is involved in formative evaluation of teachers</p>
Coherent leadership team	<p>There is a well-functioning leadership team in our school</p> <p>The leadership team tries to act as well as possible</p> <p>The leadership team supports the goals we like to attain with our school</p> <p>All members of the leadership team work in the same strain on the school's core objectives</p> <p>In our school the right man sits on the right place, taken the competencies into account</p> <p>Members of the management team / I divide their time properly</p> <p>Members of the leadership team / I have clear goals</p> <p>Members of the leadership team / I know which tasks they / I have to perform</p> <p>The leadership team is willing to execute a good idea</p> <p>It is clear where members of the leadership team are authorized to</p>

Table 4

Cronbach's α and Number of Items (n = 1902)

Scale		Cronbach's α	95% Confidence Interval		Number of items
			Lower	Upper	
Coherent leadership team		.91	.903	.915	10
	Principal	.93	.922	.932	10
Support	Assistant principals	.93	.924	.933	10
	Teacher leaders	.91	.907	.919	10
	Principal	.83	.819	.845	3
Supervision	Assistant principals	.85	.831	.855	3
	Teacher leaders	.79	.773	.805	3

Table 5

Mean, Standard Deviation, and Pearson's Correlation Coefficient (n = 1902)

		Mean (<i>SD</i>)	Average leadership		Maximum leadership		Leadership distribution		Coherent leadership team
			Support	Supervision	Support	Supervision	Support	Supervision	
Principal	Support	2.66 (0.86)							
	Supervision	2.70 (1.06)							
Assistant principals	Support	2.53 (0.86)							
	Supervision	2.19 (1.16)							
Teacher leaders	Support	2.34 (0.84)							
	Supervision	1.38 (1.08)							
Average leadership	Support	2.51 (0.71)	1						
	Supervision	2.09 (0.82)	0.60	1					
Maximum leadership	Support	2.98 (0.65)	0.86	0.47	1				
	Supervision	2.93 (0.89)	0.55	0.73	0.59	1			
Leadership distribution	Support	5.15 (0.74)	0.60	0.43	0.17	0.17	1		
	Supervision	4.32 (1.16)	0.30	0.63	0.09	0.03	0.45	1	
Coherent leadership team		2.74 (0.65)	0.67	0.35	0.59	0.41	0.40	0.08	1