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Organizational Knowledge Transfer: Introducing A Multi-Level Perspective

JAN MEROK PAULSEN

Hedmark University College

NO 2450 Rena, Norway

E-mail: jan.paulsen@hihm.no

KJELL B. HJERTØ

Hedmark University College

NO 2450 Rena, Norway

E-mail: kjell.b.hjerto@bi.no

ABSTRACT

Research on organizational knowledge transfer is burgeoning, due to the critical role of external knowledge as a source of advantages for firms as well as public sector organizations. Our study investigates knowledge transfer in the context of a Norwegian benchmarking project in which a majority of the country's municipality organizations participated over a period of two years. The explicit purpose of the project was to encourage the project groups to learn from the experiences of their partner organizations. A field sample of 82 benchmarking groups and 274 individual municipality managers were examined to test antecedents to knowledge transfer in this setting. Specifically, the relationships between knowledge transfer and group autonomy, group intensity of effort, absorptive capacity and cognitive distance were hypothesized in the current study, and possible moderator effects from group autonomy were tested on an exploratory basis. Our study was deliberately conducted using a composite multi-level design, in order to test individual and group level relationships simultaneously. The study detected a positive relationship between group intensity, group autonomy and knowledge transfer as well as a negative relationship between individual cognitive distance and knowledge transfer.

Keywords: Knowledge transfer, absorptive capacity, autonomy, cognitive distance

Two decades of knowledge management research has revealed that an organization may significantly improve its knowledge base and innovative capabilities by leveraging the skills of others (Cohen & Levinthal, 1990; Easterby-Smith, Lyles, & Tsang, 2008; Grant, 1996; Zander & Kogut, 1995). At the heart of this analysis lies the complex issue of knowledge transfer across boundaries, defined as "the process through which one unit (e.g., individual, group or division) is affected by the experience of another" (Argote & Ingram, 2000:152). Thus, knowledge transfer is manifest when some fraction of the external knowledge source is integrated with the existing knowledge bases or organizational routines of the recipient organization (Carlile, 2004). However, prior research shows uniformly that successful transfer is not easy to achieve, even within the same organization (Szulanski, 1996; Tsai, 2001). Transferring knowledge *between* organizations implies even more complexity due to the multifaceted nature of the boundaries, cultures, and the knowledge sources involved (Argote, McEvily, & Reagans, 2003; Kostova, 1999). Consequently, scholars have throughout the last decade extensively sought to identify factors that may improve or hinder the process of knowledge transfer across boundaries. Various studies have suggested that *autonomy* (Nonaka, 1994), *absorptive capacity* (Lane, Koka, & Pathak, 2006) and *intensity of effort* (Zahra & George, 2002), are positively associated with knowledge transfer, whereas the effects on knowledge transfer from *cognitive distance* are mostly negative (Nahapiet & Ghoshal, 1998; Nooteboom, Vanhaverbeke, Duysters, Gilsing, & Van den Oord, 2007). Moreover, the reviewed literature also shows that these four factors are interrelated. For example, autonomy has been found to be associated with cognitive distance (Gibson, Cooper, & Conger, 2009; Nonaka, Toyama, & Pyosiére, 2001) and intensity of effort (Büssing & Glaser, 2000). In a similar vein, absorptive capacity has been found to be related to cognitive distance (Lyles & Salk, 1996) and intensity of effort (Zahra & George, 2002). And, finally, autonomy and absorptive capacity have been found to be related to each other (Brown, 1997; Lane, Salk, & Lyles, 2001). However, to our knowledge, the current study is the first that aims to contribute to the literature by simultaneously studying the possible incremental effects of these four variables on knowledge transfer.

Furthermore, data on organizational behavior inherently consists of nested entities. For example, individuals are nested in work groups, work groups are nested in organizations, and organizations are nested in environments. Traditionally, organizational researchers have been forced to select the most appropriate level of analysis in their studies, with the consequence that important information about the variance between group members is disregarded in group studies, or alternatively, that important contextual information from the group or organization level is ignored in individually designed studies. However, by using a multilevel research method on the data, each variable may simultaneously be studied at its appropriate level of focus, no matter whether the construct is defined as an individual construct, a higher level construct (e.g. group or organization) (Chan, 1998; Hofmann, 1997; Rousseau, 1985), or as a homologous multilevel construct, where several levels of the construct are assumed to be functionally isomorphic to each other (Bliese, 2000). By using a hierarchical linear modeling (HLM) approach to the data (Randenbush & Bryk, 2002), we conducted a multilevel study where the impact of our independent variables on knowledge transfer was considered from their appropriate level of focus. Therefore, this paper also seeks to contribute to the existing literature by examining relationships between our independent variables and knowledge transfer at different levels of analysis.

THEORY AND HYPOTHESISES

Knowledge Transfer

Knowledge transfer across organizational boundaries has been a central theme in organizational learning theory since the early works (Levitt & March, 1988). For example, Huber (1991) conceptualized the process by which organizations acquired second-hand knowledge from others using the term vicarious learning. At present, the concept of knowledge transfer has been advanced theoretically through a series of studies of collaborative learning in intra-organizational and inter-organizational settings (Argote, Ingram, Levine, & Moreland, 2000; Hansen, 1999). The term knowledge transfer refers generally to an event through which one organization learns from the experience of another (Darr & Kurtzberg, 2000), and which manifests itself through the changes in the knowledge or performance of the recipient unit (Argote & Ingram, 2000). From the perspective of the recipient unit, the concept denotes a complex multi-dimensional process that embraces identification of new knowledge, translation, and modification of knowledge bases (Argote et al., 2003). The more novel a knowledge source is, the more it must be edited, re-phrased and adapted – in order to match the recipient unit's cognitive, cultural and social context (Carlile, 2004). Knowledge integration is, as such, the final stage of the transfer process. As time passes, newly transferred knowledge becomes institutionalized as it loses its novelty and becomes part of the taken for granted reality of the organization (Crossan, Lane, & White, 1999). On the other hand, a successful knowledge transfer may lead to the creation of new knowledge, simply because it stimulates creativity (Argote et al., 2003). There is, as such, an intertwined and mutually dependent relationship between knowledge transfer and knowledge creation (Nonaka, 1994). It might therefore be possible to achieve spillover effects from successful knowledge transfer, which again underscores its strategic value.

Individual Cognitive Distance

Our literature review confirms that for successful knowledge transfer to occur, people involved in the knowledge exchange settings need to share certain basic perceptions and values to sufficiently align their competencies and motives (Nooteboom et al., 2007). Again, this requires a certain shared interpretation system (Daft & Weick, 1984), established by means of shared cognitive categories of perception, interpretation and evaluation (Jensen & Szulanski, 2004). Conversely, a lack of this cognitive basis will hinder knowledge transfer between people in different settings, a phenomenon that is conceptually captured by the term cognitive distance (Nooteboom, 1999), with cognitive proximity as its inverse. Cognitive distance then, entails a discrepancy in the frames of reference between two or more people involved in exchange of knowledge – manifested in a different cognitive focus, such as perspectives, norms of conduct, and more technical capabilities (Cillo, 2005). Consequently, cognitive distance mainly represents a barrier to knowledge transfer across boundaries (Kostova, 1999), especially in the case where complex knowledge is intended to be exchanged (Cillo, 2005). The theoretical focus of cognitive distance is the individual (Nahapiet & Ghoshal, 1998), describing a negative perception among individuals about how new knowledge is interpreted and valued in the recipient unit. Accordingly, we hypothesize:

H1: Individual cognitive distance is negatively related to knowledge transfer

Autonomy

Autonomy is generally understood as the degree to which the context of the work provides substantial freedom, independence, and discretion to the individual in scheduling the work and determining the procedures to be used in carrying the work out (Hackman & Oldham, 1980). Autonomy facilitates employee communication behaviors such as expression of challenging, but constructive opinions, concerns, or new ideas about work-related issues (Tangirala & Ramanujam, 2008). The principle of autonomy can be applied at the individual, group and organizational levels – either separately or all together, although the individual is the starting point for analysis of autonomy in organizations (Nonaka, 1994).

Individual autonomy. A series of empirical works have reported positive effects of a sense of autonomy in various domains of work outcomes (Brockner et al., 2004; Spreitzer, 1995). It has for some time been posited that autonomy is positively associated with exploratory learning, – such as the search for new solutions, experimentation and the creation of new solutions (March, 1991; Weick & Westly, 1996). Specifically, goal autonomy and supervision autonomy (Lester, Beglino, & Korsgaard, 2002) facilitate higher variance and exploratory learning (Mc Grath, 2001). Autonomy also supports knowledge transfer in inter-organizational settings by encouraging greater receptivity of organizational members to new stimuli from the outside, as well as crossover collaboration and exchanges of information (Lyles & Salk, 1996). Following this line of argument we assume that the personal experience of autonomy will be positively related to the perception of knowledge transfer in an individual's organizational context. On this basis we hypothesize:

H2: Individual autonomy is positively related to knowledge transfer

Group autonomy. At the group level, autonomy describes the degree of freedom, independence and discretion in a group's work (Hackman, 1987; Kirkman & Rosen, 1999). Group autonomy entails that a group holds the power to set agendas and task boundaries for itself – in pursuit of larger goals set by the organization (Cheng & van de Ven, 1996). The group then experiences a space for freely negotiating towards shared understandings and directions of action (Crossan et al., 1999). Prior studies have revealed a positive effect of autonomy on a team's learning behavior (Kirkman & Rosen, 1999; March & Lounamaa, 1999). This effect is manifested in actively seeking out areas for continuous improvement, continuous revision of work processes, and developing alternative solutions to problems. Specifically, goal autonomy enables project groups to set agendas and change direction, and has been shown to be positively related to exploratory learning (Brockner et al., 2004). Further, research on project settings shows that project team autonomy is a promoting factor for knowledge to be transferred back to the "parent organizations" (Scarbrough et al., 2004). Thus, theoretical reasoning and empirical evidence seems to point in the direction of a positive relationship between group autonomy and knowledge transfer. Therefore we hypothesize:

H3: Group autonomy is positively related to knowledge transfer

Group Absorptive Capacity

Absorptive capacity refers in general terms to an organization's ability to recognize, value, assimilate and apply new external knowledge (Cohen & Levinthal, 1990). The construct is multi-dimensional in its nature, since it embraces the organization's capabilities to acquire external knowledge, to assimilate it across boundaries, to combine the assimilated fresh knowledge with existing stocks, and, finally, to exploit it for operational ends (Jansen, van den Bosch, & Volberda, 2005). Prior research has elicited that there may be a positive relationship between various facets of absorptive capacity and knowledge transfer across boundaries (Lane et al., 2001; Mowery, Oxley, & Silverman, 1996; Simonin, 1999). As stated in a recent meta-analysis by van Wijk and associates, "absorptive capacity plays a crucial role in increasing intra- and inter-organizational knowledge transfer" (van Wijk, Jansen, & Lyles, 2008:834). Whereas the initial work of Cohen and Levinthal (1990) used the intensity of R&D expenditures as a measure of a firm's absorptive capacity, later studies have emphasized the presence of routines and structures that facilitate the integration of new knowledge (Matusik & Heeley, 2005; van den Bosch, Volberda, & de Boer, 1999). This line of research has been further advanced by the notion of absorptive capacity as a meta-routine, defined as an overarching routine that enables people to share superior practices across the organization, and to combine and re-combine knowledge (Lewin & Massini, 2003; Lewin, Massini, & Peeters, 2009). The conceptual focus of absorptive capacity is then placed on cross-functional structures, gatekeeper roles, and team practices, in order to facilitate collective reflection, externalization of individual experiences, and sharing of knowledge (Zollo & Winter, 2002). We argue that groups play a pivotal role in operating such a meta-routine, for example by means of boundary spanning team practices (Yan & Louis, 1999), that again support knowledge transfer (Ancona & Caldwell, 1992). On this basis we hypothesize:

H4: Group absorptive capacity is positively related to knowledge transfer

Group Intensity of Effort

It seems close to self-evident that a group's learning outcome is partly a function of the efforts invested in its endeavors. Intensity of effort means in general terms that "people employ and express themselves physically, cognitively, and emotionally during performances" (Kahn, 1990:694). The term captures both the intensity of the group members' engagement in their learning tasks as well as their level of persistence (Lester et al., 2002). The more deeply the material is processed, that is the more effort used, the more the processing makes use of associations between the items to be learned and knowledge already in the memory (Cohen & Levinthal, 1990). However, the intensity of effort in a group may not be beneficial for the group's performance unless the effort is directed towards the same ends. Intensity of effort then works as an activation trigger for assimilation of new knowledge across boundaries (Zahra & George, 2002). For example, research on knowledge-intense developmental projects demonstrates that the project group's effort is critical for knowledge transfer (Ayas, 1996). We therefore hypothesize:

H5: Group intensity of effort is positively related to knowledge transfer

Group Autonomy as a Moderator

Knowledge management theory assumes that group autonomy is one of the most fundamental enabling conditions for knowledge transfer across subunit boundaries (Nonaka et al., 2001). Group autonomy encourages open sharing of ideas and openness to a wider range of possible solutions among the team members (Weick & Westly, 1996). In our review, we have found no evidence of a moderating effect of group autonomy on the relationship between our independent variables and knowledge transfer. However, several studies have confirmed that autonomy may be a significant moderator of a range of other different dependent variables (Anderson, Tolson, Firelds, & Thacker, 1990; Barrick & Mount, 1993; Johnson & Spector, 2007), even if the findings generally have been somewhat mixed (Beehr & Drexler, 1986; Konradt, Andreßen, & Ellwart, 2009). Thus, given the fundamental nature (of group autonomy), and several findings on the moderating potential of this construct on several other relationships, we may assume on an exploratory basis that group autonomy may be beneficial for the relationship between our other independent variables and knowledge transfer. We also explore whether there is an interactive effect between individual autonomy and group autonomy on knowledge transfer.

METHOD

Data

A field sample of 82 benchmarking project groups and 274 individual responses were examined to test the relationships described in the hypotheses. To investigate the data we used self report questionnaires, completed as a net-based survey, to conduct a non-experimental theory-based evaluative correlation design (Shadish, Cook, & Campbell, 2002). The groups were ongoing project groups at the top and middle management levels in municipality organizations. The average age of the respondents was 44 years, with 41% men and 59% women. The group members in the samples had worked together in benchmarking projects during a period of two years. All participants were asked to evaluate learning processes and effects, project conditions and their efforts in benchmarking over a two-year period. All questionnaires except group size were reported on a 5-point Likert scale ranging from 1 (*to a very little extent*) to 5 (*to a very great extent*). For control reasons we collected data about the respondents' sex, age, and their group size.

Measures

To measure *autonomy,* we used 3 items reflecting autonomy as used in psychological empowerment scales (Kirkman & Rosen, 1999; Spreitzer, 1995), but adapted to a benchmarking project setting. The respondents were for example asked to what extent they had the opportunity to influence the choice of working methods applied in the benchmarking seminars. To measure *absorptive capacity* we modified 3 items from the multi-dimensional absorptive capacity scale developed by van den Bosch, Volberda and de Boer (1999). The respondents were for example asked to what extent they experienced a systemic learning capacity in their recipient organization on a five-point Likert-type scale with 1 for "never" and 5 for "to a very large extent". *Intensity of effort* is measured by 3 items developed by us for this present study. The respondents were asked to assess the time investments of their project group on a scale. To measure *knowledge transfer* we modified 4 items drawn from the knowledge transfer scales developed by Szulanski (1996) and Simonin (1999). Respondents were asked to what extent they experienced transfer and utilization of 'best practices' from the benchmarking project on a five-point Likert-type scale. As for *cognitive distance*, three items addressed at the individual level measured this construct. Finally, the respondents' *sex*, *age*, and group size was collected as control.

Analysis

All constructs used in this paper build on theory and established scales. However, as we have made several modifications of our scales, and as analyzes of variance in self-reporting measured data sets raises the question of common method variance, we ran an explorative analysis (EFA) prior to a subsequent confirmative analysis (CFA) of the data.

Exploratory Factor Analysis of the Data Matrix

The exploratory factor analysis (principal component with varimax rotation) of the 16 items revealed a fairly consistent five factor structure. All five constructs had an eigenvalue above 1.19, and the eigenvalue of the first non-significant factor was .85. The five factors explained 63.5% of the variance. 15 of the 16 factors had loading that varied between .54 (the only one under .60) and .82, and had no cross loadings. The 16th factor, measuring autonomy, had a weak loading (.44) on the main factor and a high cross-loading on transfer knowledge (.38). However, the construct reliability (Chronbach's Alpha) of autonomy was .72. For the other constructs the reliability was .62 for intensity of effort, .78 for absorptive capacity, .59 for cognitive distance, and .82 for the dependent variable, knowledge transfer. A reliability at .60 is considered "small" by some (Nunnally & Bernstein, 1994:533), whereas others characterized loadings in explorative analysis above .50 as "strong" (Osborne & Costello, 2004). Even if the EFA analysis revealed a fairly defensible factor structure and construct reliabilities, the solution seems nonetheless to be in need of a closer confirmative analysis of the data.

Confirmative Factor Analysis of the Measurement Model

To inspect the factor structure found in the explorative factor analysis, we used the LISREL 8 program to conduct a *confirmative factor analysis (CFA)*, using maximum likelihood estimates on the data (Jøreskog & Sörbom, 1993). The matrix of all constructs converged, with a chi-square at 122.82, with 94 degrees of freedom (p = .02). Of selected fit indices, the RMSEA was considered informative (Cudeck & Browne, 1983). A RMSEA below .08 is characterized as an appropriate fit by Jöreskog and Sörbom (1993), and below .05 as a close fit. The RMSEA was .045. The RMSEA may be especially informative when studying the narrowness of its confidence interval

(Kelley & Rauch, 2006). The 90 percent confidence interval of RMSEA was between .017 and .065. The overall absolute goodness of fit indicator (GFI) was .91, adjusted GFI (AGFI) was .87, and the normed fit index NFI (Bentler & Bonett, 1980) was .88. Recently, the comparative fit index CFI (Bentler, 1990) has been recommended as a replacement for the NFI (Williams & O'Boyle, 2008), as the CFI is a sample independent index and does not assume that each measurement indicator is completely independent of the others. The CFI was .97. All in all, and even if the AGFI and the NFI were slightly below the appropriate level of .90, we deem the factor structure suggested in the EFA as appropriate, and no sign of inappropriate common method variance was indicated.

A Multilevel Approach to the Independent Variables

In our theory chapter, we hypothesized that there may be a positive relationship between knowledge transfer and individual cognitive distance, individual autonomy, group autonomy, group absorptive capacity, and group intensity of effort, respectively. In collecting data for analysis of variables at multiple levels (Rousseau, 1985), we suggested three areas where a level should be specified for the variables. First, the level of measurement, which is the level where generalizations are made. Second, the focal unit, which is the unit where the data is directly attached. Third, the level of analysis, which is the level where data is assigned for hypothesis testing and statistical analyzes. The problems involved in finding the consequences of differences in focal unit, level of measurement and level of analysis, are considered as the basis of the methodological difficulties of multilevel research (Rousseau, 1985).

All of our constructs are measured at the individual level. With regards to cognitive distance, the level of focus, and the level of analyses for the hypothesis, is also at the individual level, and we have suggested that individual cognitive distance is negatively related to knowledge transfer (Hypothesis 1). The level of focus for the items measuring autonomy is neither the individual, nor the group, but refers to the environment of the whole project, in which all groups are attached. Thus, autonomy is defined as a homologous multilevel construct (Nonaka, 1994), where the relationship between autonomy and knowledge transfer is assumed to hold both at individual and group level (Kozlowski & Klein, 2000). At the individual level, we have hypothesized that individual autonomy is positively related to knowledge transfer (Hypothesis 2). To also be able to investigate autonomy at the group level, we intend to apply a composition process by aggregating the individually reported experiences of autonomy to the group level, in a “direct consensus model” (Chan, 1998), assuming that this group level construct is functionally isomorphic to the individual level construct (Bliese, 2000). We have suggested that group autonomy is also positively related to knowledge transfer (Hypothesis 3). Even if Hackman (2003) has made a strong argument in support of this approach, Kozlowski and Klein (2000: 45) warn about the general tension inherent in the creation of homologous construct models: ”good ones have the potential to advance and unify our [organizational] field, but weak ones offer little to our understanding of organizational phenomena” (bracket added). However, we think that agreement among group members about their own autonomy may give an awareness of an additive strength towards the environment, and that this strength may invoke an incremental effect above the individual effect on the variation in the knowledge transfer perception of the individual. We thus assume that both individual autonomy and group autonomy may possess a complementary explanatory power that may advance and unify our understanding of the knowledge transfer process.

We defined absorptive capacity and intensity of effort as group level constructs, and thus we are referring our questions to the group level for both constructs, with an intent to aggregate the individually measured constructs to the group level in a process called a ”fuzzy composition process” (Bliese, 2000), or a “referent-shift consensus” process (Chan, 1998). These types of group constructs are assumed to be simultaneously related to, and different from their individual level constructs (Bliese, 2000). In Hypothesis 4 and Hypothesis 5 we proposed that both group absorptive capacity and group intensity of effort were positively related to knowledge transfer, respectively. To improve the accuracy and the construct validity of these group constructs, we asked descriptive, perceptual questions (Glick, 1985), and the questions explicitly addressed the group as the focal unit.

Aggregation from Individual to Group Level

Individually measured constructs that are aggregated to group level need to empirically demonstrate adequate within-group reliability in relative consistency among responses (Bliese, 2000). To test the reliability of the group level constructs we calculated the one-way random-effects ANOVA, the Intraclass Correlation Coefficient measures ICC1, and ICC2 (James, 1982). The ICC1 can be interpreted as the degree of reliability associated with a single assessment of the group mean, or as an index of interrater reliability. ICC1 varies from -1 to 1. When ICC1 is large, a single rating from an individual is likely to provide a relatively reliable rating of the group mean. When ICC1 is small, multiple ratings are recommended to increase reliable estimates of the group mean (Bliese, 2000). ICC2 represents the reliability of the overall sample mean, is linked mathematically to ICC1 by the group size in the sample (James, 1982), and is equivalent to the overall sample-mean reliability estimate (Bliese, 2000).

The F test indicated a significant main effect of group membership for autonomy ($p < .05$), a marginally significant effect for intensity of efforts ($p = .068$), and an insignificant effect for absorptive capacity ($p = .171$). James (1982) reported that ICC1 values typically range from .00 to .50, with a median of .12. The ICC1 was .15 for autonomy, .08 for absorptive capacity, and .10 for intensity of effort. The ICC2 should have values above .50 to be considered as tolerable (Klein et al., 2000). The ICC2 for autonomy was .39, for absorptive capacity .24, and for intensity of effort it was .29. We may note that ICC2 is conservative in that it supposes a subsample from an infinite pool of potential raters or informants (Simons & Peterson, 2000). Whether the appropriateness of aggregation from individual assessment to group level should rest on one indicator or more than one, pointing in the same direction, is a question that is not yet concluded (see discussion and simulation in Klein and colleagues (2000). In our case, and following the general advice reported above, a decision to aggregate autonomy, absorptive capacity, and intensity of effort to a group level would have to rest on only one indicator, the F-test, as the ICC(1) and ICC(2) variables may not be considered as strong enough to justify aggregation. However, Bliese (2000) argue that as long as the ICC(1) is above zero, analyses involving aggregate-level variables may be quite valuable for fuzzy composition models, and may not be dismissed as flawed. Thus, we assume that a decision about aggregating a variable may in the end be grounded on a pragmatic balancing between the need for conceptual clarity about what we have actually measured, and factually statistical indications of contextual effects above the individual level. With this in mind, we decided to deem the statistics as sufficiently supporting the appropriateness of aggregating autonomy and intensity of effort to the group level. However, in the case of absorptive capacity, the insignificant F test and the rather low ICC values indicated that our theoretical assumptions of a group-level construct may not be appropriate, and our hypothesized relationship between group absorptive capacity and knowledge transfer may not be tested. Despite this, we decided to investigate a possible individual effect of group absorptive capacity, to see whether the results from this analysis would indicate that absorptive capacity in future research may be more properly investigated at the individual level of focus, and not the group level (Hackman, 2003).

Descriptive Statistics

Table 1 reports means, standard deviations, and intercorrelations at the individual and group level for the variables included in the analysis. The matrix is useful for further assessment of the extent to which common method variance explains relationships among the constructs. The correlation between the variables (except for control variables) are moderate, with a maximum of +.42 at the individual level, and +.52 at group level, both levels for the correlation between autonomy and knowledge transfer. The matrix also includes simple correlations with sex, age, and group size. At the individual level, the highest correlation with the other variables was .07 (p = .283), and for the sake of not blurring the analysis with redundancy, we removed all control variables at the individual level. At the group level, sex rate and average age had significant or marginally significant relationships with the explanatory variables, and we included them in the further analysis, whereas group size was completely removed from the model.

Insert TABLE 1 about here

Hierarchical Linear Modeling

As our model describes relationships that predominantly comprise variables at two different levels, we opted to analyze the data with HLM (Bryk & Randenbush, 1992). In HLM analysis, questions about cross-level relationships in multilevel studies can be formulated as two-level random intercept and random regression slope models (Bryk & Randenbush, 1992). The random intercept model can be applied when key predictors include variables measured at both the individual and group levels, respectively, and when the outcome variable is measured at the individual level. The general model that would be established for the individual and group level effects is:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + r_{ij}$,

Level 2: $\beta_{01} = \gamma_{00} + \gamma_{01} W_j + u_{0j}$

$\beta_{1j} = \gamma_{10} + \gamma_{11} W_j + u_{1j}$

where Y_{ij} is the outcome measure for the *i*th individual in the *j*th group, β_{0j} and β_{1j} are the intercept and slope, respectively, X_{ij} is the value on the predictor for individual *i* in group *j*, and r_{ij} is the variability within the group. In the Level 2 equations, γ_{00} and γ_{01} are the Level 2 intercepts; γ_{10} and γ_{11} are the Level 2 slopes, *Wj* is a group-level variable, and u_{0j} and u_{1j} are random errors associated with the group *j* (see Bryk and Raudenbush, (1992) and Hofmann, (1997) for further details).

RESULTS

The Unconditional Null Model

To assess the group effect of the model, we first inspected an unconstrained two-level version of the model with no predictors.

Level 1: (Knowledge transfer)$_{ij} = \beta_{0j} + r_{ij}$

Level-2: $\beta_{0j} = \gamma_{00} + u_{0j}$

where "(Knowledge transfer)$_{ij}$" means the *i*th individual in the *j*th group's experiences of knowledge transfer. β_{0j} is the mean of knowledge transfer, r_{ij} refers to the variability between members within a group, and u_{0j} refers to the variability between the groups. We assume that $u_{0j,}$ is independent and normally distributed with a mean of 0 and a τ_{00} group level variance ($N(0,\tau_{00})$). The mixed model of these two models would be (Knowledge transfer)$_{ij} = \gamma_{00} + u_{0j} + r_{ij}$. When first looking at the fixed effects (see Table 2, Null Model), the mean across all individuals of their experiences of knowledge transfer was $\gamma_{00} = 2.96$, on a scale from 1 (*not at all*) to 5 (*to a great extent*).

Insert TABLE 2 about here

The group random effect variance was $\tau_{00} = 0.20$ (see Table 2, Null Model), and significantly different from null ($\chi^2[81] = 171.23$; $p < .001$). Thus we conclude that the group level may be useful in further analyses. The intraclass correlation coefficient (ICC) measures the proportion of variance in the knowledge transfer variable that is accounted for by the groups. As the individual random effect variance was $\sigma^2_r = .52$, the ICC is calculated to $\rho = \tau_{00} / (\tau_{00} + \sigma^2_r) = .20 / (.20 + .52) = .28$, which also indicates that studying the group level effects may be useful. The reliability of the sample mean can be calculated by averaging the reliability of each group, and the reliability was .51, which is low, but tolerable.

Model 1: A Two-Level Intercept Regression Model without Random Slopes

We now elaborate the Null model by simply adding the independent variables investigated in this paper into the model. The main purpose of this model is to directly compare the incremental predictive ability of Model 1 compared to the Null model, without having to consider the variances of the slopes (Snijders & Bosker, 1999).

Model 1

Level-1: **(**Knowledge transfer**)** $_{ij}$ = β_{0j} + β_{1j}(**Sex**) + β_{3j}(**Cognitive distance**) + β_{4j}(**Autonomy**) + β_{5j}(**Absorptive capacity**) + r_{ij}

Level-2: β_{0j} = γ_{00} + γ_{01}*(***Sex ratio***) + γ_{02}*(***Group size***) + γ_{04}*(***Autonomy***) + γ_{05}*(***Intensity of effort***) + u_{0j},

When comparing the random effects of Model 1 with the Null model at level-1 (see Table 2), the prediction ability at the individual level of the two models can be compared by using the formula $R_1^2 = 1 - (\tau_{00} + \sigma^2_r)_{M1} / (\tau_{00} + \sigma^2_r)_{M0}$. The prediction ability at the group level can accordingly be compared by using the formula: $R_2^2 = 1 - (\tau_{00} + \sigma^2_r/n)_{M1} / (\tau_{00} + \sigma^2_r /n)_{M0}$, where "n" is the typical number of level-1 units in any level-2 unit. For this calculation we used the average number of group members in our sample, which were 3.70. R_1^2 was .26, and R_2^2 was .35, which means that the prediction ability at the individual level improved by 26% by including our variables, whereas the predictive ability at the group level was improved by 35% by including our variables.

Particularly, for comparison of the proportion reduction in variance at level-1 for Model 1 with the Null model, we may use the formula: $(\tau_{00\_M0} - \tau_{00\_M1}) / \tau_{00\_M0}$. Accordingly, we may compare the proportion reduction in variance at level-2 of the two models by the formula: $(\sigma^2_{M0} - \sigma^2_{M1}) / \sigma^2_{M0}$. The calculation revealed that the proportion reduction in variance at level-1 was .18, which means that 18% of the individual variance of knowledge transfer is accounted for by sex, individual cognitive distance, individual autonomy, and individual absorptive capacity. The proportion reduction in variance at level-2 was .47, which means that 47% of the true between-group variance in knowledge transfer is accounted for by the group's sex ratio, group size, group autonomy and group intensity of effort. However, even if a drop in random effect variance of the grand mean at group level (τ_{00}) from .20 in the Null model to .11 in Model 1 is considerable, a chi-square test indicates that the remaining variance of .10 is significantly different from zero ($\chi^2[77] = 131.08$; $p < .001$), which means that there still remains a substantial amount of unexplained variance at the group level in Model 1, after the introduction of our variables (Randenbush & Bryk, 2002).

The results of the fixed effects are listed in Table 2, Model 1. The preliminary statistics for the hypotheses reveal that individual cognitive distance, albeit its negative value, was not related to knowledge transfer, and Hypothesis 1 is not supported. The homologous defined construct autonomy was significantly related to knowledge transfer, both at the individual level ($p < .01$), supporting Hypothesis 2, and at the group level ($p < .001$), supporting Hypothesis 3. Whether individual absorptive capacity is related to knowledge transfer we can't know, as the questions measuring this variable are directed at the group level. Thus, Hypothesis 4 is indecisive. However, "individual group absorptive capacity" was strongly related to knowledge transfer ($p < .001$), which indicates that absorptive capacity at the individual level may be further investigated. Finally, group intensity of effort was related to knowledge transfer ($p < .01$), and Hypothesis 5 is supported.

Model 2: Intercept and Slopes-as-Outcomes Model

Building on Model 1 we designed a new model where we allowed the slopes for the relationship between knowledge transfer and individual autonomy, individual absorptive capacity, and individual cognitive distance, to vary randomly across the groups. Our first task was to examine whether the incremental values were strong enough to justify the new model. If not, the model may be dropped (Bryk & Randenbush, 1992). Due to the sample size, the chi-square statistics for the random effects for a complete model would be based on only 18 of 82 units, which would give unstable results. We therefore inspected three sub-models, each of them including the slope for each of the three individual relationships with knowledge transfer, respectively, to see whether any of these sub-models had a substantially lower deviance than a random intercept model (Randenbush & Bryk, 2002), which in our paper would be Model 1.

The reduction of deviance compared to Model 1 was ignorable for the sub-model, including individual autonomy, and individual group absorptive capacity. For the sub-model for individual cognitive distance we found, however, a noticeable lower deviance than in Model 1. Thus, we decided to go further in our analysis with this sub-model, hereafter called "Model 2". The model is identical with Model 1, except for the slope for cognitive distance – knowledge transfer, which is allowed to vary randomly across the groups, by adding the formula $\beta_{3j} = \gamma_{00} + u_{04}$ to the model (see Model 1).

The results for the random effects in Model 2 are listed in Table 3. The deviance of Model 2 compared to the null model was highly significant. The difference between Model 2 and Model 1 was marginally significant ($\Delta D_{\text{M1-M2}} = 5.15$, $df = 2$; $p < .10$). Particularly, the reliability of the intercept increased from the somewhat unacceptable .41 in Model 1 to .51 in Model 2, which is still low, but tolerable. The sum of the variances of the residuals in Model 2 ($\tau_{00} + \tau_{11} + \sigma_r^2$) was .59, compared to .53 for the variances in Model 1 ($\tau_{00} + \sigma_r^2$), and .72 in the Null model. We notice that the variance for the intercept residual increased from .11 in Model 1 to .13 in Model 2, whereas the variance for the level-1 effects (σ_r^2) was reduced from .42 in Model 1 to .35 in Model 2. The input difference between Model 1 and Model 2 is the introduction of one random slope, for the cognitive distance – knowledge transfer relationship. The random variance of the slopes for this relationship, Var(u_{03}) = τ_{11}, was significant (τ_{11} = .11, χ^2 = 108.63, df = 76, p < .01). The reliability of the slope β_{4j} was, however, .22, which means that estimates of the slopes for each group measuring the impact of cognitive distance on knowledge transfer are not very reliable. The correlation between the intercept and the slope was .02, indicating the association between the group means and the cognitive distance effects on knowledge transfer. The correlation in a model where group size is not controlled for, as is in Model 2, was still as low as .04. All in all, we deemed the improvement from Model 1 to Model 2 to be sufficient to justify Model 2.

The results for the fixed effects in Model 2 are listed in Table 3.

Insert TABLE 3 about here

We note from comparing Table 3 with Table 2 that the differences between Model 2 and Model 1 concerning the fixed effects are ignorable, and all our preliminary conclusions about the hypotheses discussed in association with Model 1 remained unchanged, as did their levels of significance. We may therefore perceive our preliminary conclusions concerning our hypotheses from analyzing Model 1 as confirmed in Model 2..

Model 3: Intercept and Slopes-as-Outcomes Model with one Moderator

As for possible moderator effects on the relationships described in Model 2, we have argued in the theory chapter that group autonomy might be a promising candidate for further exploration. Thus, we introduced group autonomy in the fixed slope equations for autonomy and absorptive capacity, and in the random slope equation of cognitive distance. The only noticeable incremental moderating effect compared with Model 1 was found in the cognitive distance – knowledge transfer relationship. Thus, our final model, which is Model 3, would look like this:

Model 3

Level-1: **(**Knowledge transfer**)** $_{ij}$ = β_{0j} + β_{1j}(**Sex**) + β_{3j}(**Cognitive distance**) + β_{4j}(**Autonomy**) + β_{5j}(**Absorptive capacity**) + r_{ij}

Level-2: β_{0j} = γ_{00} + γ_{01}*(***Sex ratio***) + γ_{02}*(***Group size***) + γ_{04}*(***Autonomy***) + γ_{05}*(***Intensity of effort***) + $u_{0j,}$

β_{3j} = γ_{00} + γ_{34} (***Autonomy***) + u_{03}

where γ_{34} refers to the cross-level interaction of group autonomy and individual cognitive distance. According to our theory, we referred to this interaction effect as a moderator effect of group autonomy on the relationship between individual cognitive distance and knowledge transfer.

The results of the random effects in Model 3 are listed in Table 3. We recall that the difference in deviance between Model 2 and Model 1 was marginally significant (ΔD_{M1-M2} = 5.15, df = 2; p < .10). When comparing Model 1 with Model 3, however, the difference became clearly significant ($\Delta D_{M1\text{-}M3}$ = 10.03, *df* = 2; *p* < .01). The reliabilities of the intercept and slope estimates were unchanged from Model 2. The sum of the variances of the residuals in Model 3 ($\tau_{00} + \tau_{11} + \sigma_r^2$) was .57, compared to .59 for the variances in Model 2. The difference was mainly due to a drop in the variance of the cognitive distance residual (τ_{11}), which had a drop from .11 in Model 2 to .09 in Model 3 (τ_{11} = .09, χ^2 = 100.40, *df* = 75, *p* < .05). As we may notice, there is still a significant unexplained variance in the slope for cognitive distance, however, the variance is moving closer to an insignificant level. All in all, we deemed the improvement from Model 2 to Model 3 to be sufficient for justifying Model 3.

The results for the fixed effects in Model 3 are listed in Table 3. We note that group autonomy moderates *negatively* the relationship between cognitive distance and knowledge transfer (*p* < .01). Based on the information from the analysis, we used the procedure explained by Aiken and West (1991), to illustrate the interaction of group autonomy on the cognitive distance – knowledge transfer relationship, see Figure 1.

Insert FIGURE 1 about here

The figure illustrates earlier findings by showing that the knowledge transfer is higher when group autonomy is in the upper half of the sample, compared to when group autonomy is in the lower half of the sample, regardless whether the cognitive distance is high or low. The figure also illustrates the negative moderating effect of group autonomy on the relationship between individual cognitive distance and knowledge transfer. When group autonomy is low, an increased cognitive distance does not seem to affect the perception of knowledge transfer of the individual. Conversely, in groups where autonomy is high, an increased cognitive distance seems to be detrimental to the individual's perception of knowledge transfer. However, neither of the two slopes, each representing the upper and the lower half of group autonomy in the sample, were significant (high autonomy: t = .25, n.s.; low autonomy: t = -1.27, n.s.).

Controlling for the Other Levels

The theoretical meaning of a construct that is studied at a level other than its theoretical focus may be problematic to comprehend (Bliese, 2000; Chan, 1998; Rousseau, 1985). However, when individual cognitive distance and group intensity of effort are tested purely at their theoretical level of focus, we completely disregard potentially meaningful other-level variances in these constructs. This is also the case for the absorptive capacity construct in our study, where the reliability of the group composite was too weak to justify aggregation of the individually collected data to the group level, as we had intended to do. Indeed, as Bliese (2000: 376) pointed out: "when ICC(1) values are greater than zero [as is the case for all constructs in this study], contextual effects are present, and one's aggregated-level construct is no longer directly equivalent to one's lower-level construct. Rather than dismiss aggregate-level effects and aggregate-level variables as flawed, I believe that analyses involving aggregate-level variables may be quite valuable in furthering our understanding of organizational behavior." (brackets added). This point of view is strongly supported by Hackman (2003), who argued for the necessity of "bracketing" one's focal phenomenon by attending to constructs at both higher and lower levels of analyses. In this paper we have followed this line of reasoning particularly concerning the absorptive capacity construct, which happened to be strongly significantly related to knowledge transfer at a different level than we theoretically had hypothesized. A check of possible up-or-down level effects of all our independent variables on knowledge transfer may be interesting from an explorative point of view, and give rise to further theoretical discussions about the appropriateness of the level of focus for the construct in hand. Thus, we decided to rerun Model 1, and this time with all four variables included on both level-1 and level-2. We labeled this extra model "Model 1C", and the model looks like this:

Model 1C – Level Controlled

Level-1 predictors: **(**Knowledge transfer**)** $_{ij}$ = **(**Knowledge transfer**)** $_{ij}$ = β_{0j} + β_{1j}(**Sex**) + β_{3j}(**Cognitive distance**) + β_{4j}(**Autonomy**) + β_{5j}(**Absorptive capacity_C**) + β_{6j}**(Intensity of effort_C)** + r_{ij}

Level-2: β_{0j} = γ_{00} + γ_{01}*(***Sex ratio***) + γ_{02}*(***Group size***) + γ_{03}****(Cognitive distance_C)*** + γ_{04}***(*****Autonomy*****)** + γ_{05}***(*****Absorptive capacity*****)** + γ_{06}***(*****Intensity of effort*****)** + $u_{0j,}$

where "_C" indicates control variables. The term "Absorptive capacity_C" is synonymous with what we have called "individual group absorptive capacity", and refers to the fact that the level of focus of the construct at the outset of our theory was actually the group. From this point of view, the individual effect of absorptive capacity would have to be considered as a control level construct (Hackman, 2003). The analysis showed that none of the control variables, except for "Absorptive capacity_C", was related to knowledge transfer, and there were no indications of changes in the conclusions that were drawn earlier about the hypotheses in this paper.

Summary of findings

In this study we have brought evidence to a multilevel, and simultaneously conducted perspective on the relationships between knowledge transfer and autonomy, absorptive capacity, intensity of effort, and cognitive distance, respectively. We defined and measured autonomy as a homologous multilevel construct, and found that individual autonomy, as well as group autonomy, was positively related to the individual's experiences of knowledge transfer. Simultaneously, group intensity of effort was found to be positively related to knowledge transfer, whereas we found no relationship between individual cognitive distance and knowledge transfer, when controlling for the other explanatory independent variables. Finally, from our reading of the theory, we assumed that absorptive capacity was most appropriately considered and measured as a group variable. That was not the case, in this study. No convincing empirical evidence of a group absorptive capacity construct was found, and we decided to include absorptive capacity in our further analyses as an individual variable, even if the items measuring the construct were addressed at the group level. We labeled this construct "individual group absorptive capacity", and the construct was clearly positively related to individual knowledge transfer. In addition to our hypotheses, we investigated explicitly whether group autonomy moderated any of the relationships between our independent variables and knowledge transfer, respectively. We found that group autonomy moderated the relationship between individual cognitive distance and individual knowledge transfer negatively. Thus, when group autonomy is high, the negative effect of cognitive distance on knowledge transfer seems to be stronger than when group autonomy is low. Finally, we checked whether a two-level intercept regression model without random slopes for all variables at both levels would reveal any extra effects, but it did not. The study was conducted controlled for the respondents' sex and the size of the groups, after having eliminated the group members' ages, as the correlation matrix indicated that age as a control factor was ignorable.

DISCUSSION

The reported study confirms the importance of individual and group level autonomy in goal setting, supervision and design of the learning context, and, thus, we recommend the construct to be studied at multiple-levels. Although we have conceived absorptive capacity as a group construct, the study shows significant effects solely on the individual level. However, as scholars have argued that an organization's absorptive capacity is shaped by abilities residing at multiple levels – individual, group and subunit (Cohen & Levinthal, 1990; Matusik & Heeley, 2005), the "mixed message" from our study therefore underscores the importance of further investigation of the multi-level nature of the construct. What is more, the notion of absorptive capacity as a meta-routine (Lewin & Massini, 2003) finds resonance in the present study. Absorptive capacity is then conceived as an overarching routine that shapes the ability to integrate, build, and reconfigure internal competencies (Zollo & Winter, 2002). We see this approach as a promising one for further empirical investigation. Our study confirms intensity of effort as an intrinsic group-characteristic that influences knowledge transfer positively, and we point to its antecedent as an interesting path for further modeling of knowledge transfer. The psychological conditions of group intensity of effort, such as psychological safety (Edmondson, 1999) and meaningfulness (Thomas & Welthouse, 1990), might thus be elaborated and tested in a three-stage model of knowledge transfer. The reported study also justifies taking cognitive distance into account in modeling knowledge transfer. Nooteboom and associates have suggested that there is an inverted-U shaped relationship between cognitive distance and inter-organizational learning (Nooteboom et al., 2007). They posit that a small portion of cognitive distance between learners might yield opportunities for novel combinations and may stimulate creativity, whereas at some point, a high level of cognitive distance becomes a learning barrier

(Cillo, 2005). Our study does not display a non-linear relationship, but on the other hand, our confirmed model shows a moderating effect from group autonomy on the hypothesized negative relationship between cognitive distance and knowledge transfer. The negative, albeit non-significant (p = -.11, t = -1.51, *n.s.*) relationship between individual cognitive distance and knowledge transfer seems to be strengthened in groups with high group autonomy, compared to groups with low group autonomy, which is somewhat surprising. In a group with high autonomy, a high cognitive distance seems to be more damaging to the experience of knowledge transfer than in groups with low autonomy. As we have no theory to underpin this finding, we hope that other researchers may see this finding as interesting for further scrutiny and, generally speaking, our study underscores the need for further investigation of the multiple effects of cognitive distance in inter-organizational learning. Finally, the findings of this study may be considered also from a multi-variable analysis perspective. To our knowledge, no studies have investigated simultaneously the relationships between knowledge transfer and autonomy, cognitive distance, intensity of effort and absorptive capacity, respectively, in a joint model. Given that several studies have found these explanatory variables to be correlated at different levels, the incremental effect of each of these variables can only be found in a joint study where all variables are included. For example, when the insignificant relationship between individual cognitive distance and knowledge transfer was investigated separately, the relationship became marginally significant (β = -.12, t = -1.84, p = .06).

Limitations

The contributions of this research should be viewed in the light of several limitations. First, the data was collected at one point in time, which makes it impossible on a strict basis to draw inference of causality or rule out reverse causality. Consequently, longitudinal or experimental studies are recommended, in order to more closely approach causality inferences on the relationships detected in this study. Second, even if the CFA analysis reported acceptable results, we are not permitted to completely rule out the possibility that common method variance has artificially inflated the relationships we have studied. In particular, the validity of the dependent variable knowledge transfer would most likely benefit from being measured in a separate survey. Third, instead of removing group absorptive capacity from the study when the aggregation of this variable from individual to group level was found to be inappropriate, we decided to include the variable in the model, under the label "individual group absorptive capacity". Consequently, the interpretation of our findings concerning this construct had limitations, or with the limitations that followed in the interpretation of our findings concerning this construct as a consequence. Finally, we underscore that the hierarchical level modeling approach presumes that the dependent variable is limited to being measured at the individual level.

Conclusions

Our study confirms that organizational learning is a multi-level process, by displaying both group-effects and individual effects on knowledge transfer. Our analysis displays a dynamic of two group-factors, i.e. group autonomy and group intensity of effort, in concert with personal cognitive distance and individual autonomy that jointly provide significant explanatory power to knowledge transfer in inter-organizational settings. In addition to the implicit multi-level argument, our study points to the crucial role of the group level in organizational learning.

Tables

TABLE 1

Correlations, Standard Deviations, and Means

	Mean	SD	1	2	3	4	5	6	7
Individual level									
1 Sex	1.41	.49							
2 Age	5.37	.84	-.25**						
3 Group size	3.27	1.03	-.07	.00					
4 Knowledge transfer	2.95	.85	.00	-.03	.03				
5 Autonomy	3.36	.87	.03	-.02	-.03	.42**			
6 Intensity of effort	3.58	.58	.06	.03	.03	.30**	.20**		
7 Absorptive capacity	3.11	1.01	-.07	-.04	-.03	.37**	.29**	.34**	
8 Cognitive distance	2.70	.89	-.01	-.04	-.10	-.13	-.08	-.13	-.21**
Group level									
1 Sex	1.43	.33							
2 Age	5.38	.55	-.36**						
3 Group size	3.01	.97	-.08	-.08					
4 Knowledge transfer	2.97	.62	-.01	.05	.04				
5 Autonomy	3.38	.58	.01	-.11	-.08	.52**			
6 Intensity of effort	3.13	.64	.26*	-.12	-.08	.33**	.28*		
7 Absorptive capacity	3.57	.39	-.07	-.19	.03	.34**	.21	.31**	
8 Cognitive distance	2.73	.57	-.06	.02	-.12	.00	.09	-.46**	-.22

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
List wise N=233 for individual level and N=83 for group level.

TABLE 2

Null Model and Two-Level Intercept Regression Model (Model 1)

Outcome variable: Knowledge transfer							
Null model: Unconstrained (null model)							
Fixed effects		Coeff.	SE	*df*	*t*	Sign	
Intercept	γ_{00}	2.96	.07	81	42.81	***	
Random effects		VC		*df*	X^2	Sign	
Intercept	u_{oj}	.20		83	171.23	***	
		.52					
Model 1: Two-Level Intercept Regression							
Fixed effects		Coeff.	SE	*df*	*t*	Sign	
Individual level							
Sex	γ_{10}	.05	.10	224	.62	*n.s.*	
Cognitive Distance	γ_{30}	-.10	.07	224	-1.27	*n.s.*	*H1*
Autonomy	γ_{40}	.20	.07	224	2.80	**	*H2*
Absorptive capacity	Γ_{50}	.22	.05	224	4.58	**	*(H4)*
Group level							
Intercept2	γ_{00}	2.96	.05	77	54.77	***	
Sex ratio	γ_{01}	-.17	.16	77	-1.09	*n.s.*	
Group size	γ_{02}	.03	.05	77	.62	*n.s.*	
Autonomy	γ_{04}	.52	.11	77	4.88	***	*H3*
Intensity of Effort	γ_{06}	.47	.17	77	2.72	**	*H5*
Random effects		VC		*df*	X^2	Sign	
Intercept	u_{oj}	.11		77	131.28	***	
Level-1	*r*	.42					

[1] Final estimation of fixed effects (with robust standard errors

[2] Preliminary tests, without allowing random slopes

TABLE 3

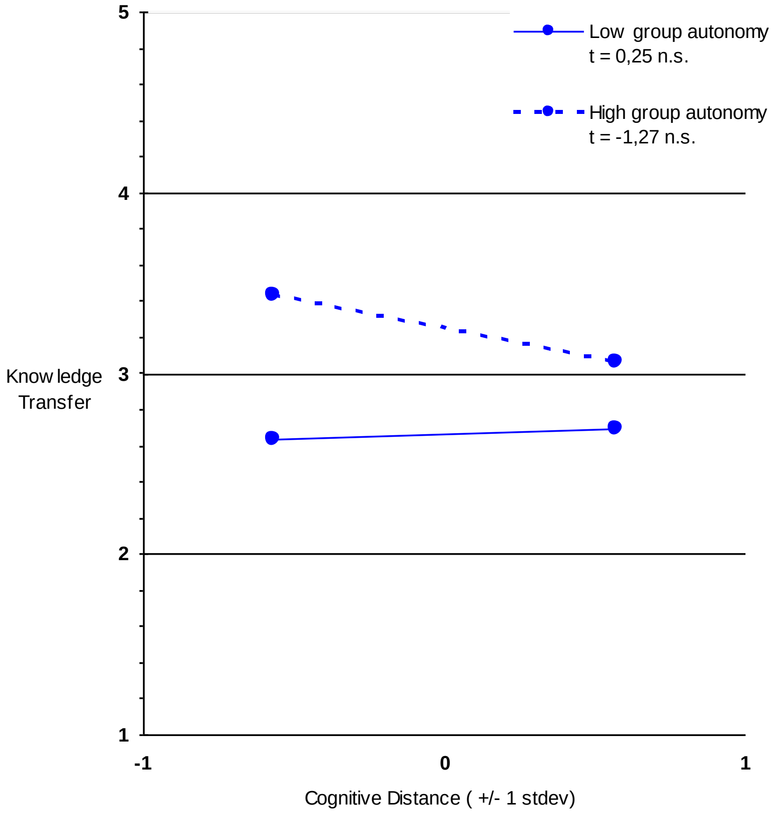
Intercept model (Model 2) and Slope-as-Outcome Model (Model 3)

		Model 3					Model 2					
Fixed effects		Coeff	SE	*Df*	*T*	*Sign*	Coeff	SE	*df*	*t*	Sig	*Hypo-theses*
Individual level												
Autonomy	γ_{20}	.20	.07	223	2.97	**	.21	.07	224	3.00	**	
Sex	γ_{10}	.06	.10	223	.56		.05	.10	224	.51		
Cognitive Distance	γ_{30}	-.11	.07	80	-1.51		-.10	.07	81	-1.28		*H1*
Autonomy	γ_{20}	.20	.07	223	2.97	**	.21	.07	224	3.00	**	*H2*
Absorptive Capacity	γ_{40}	.22	.05	223	4.53	***	.22	.05	224	4.38	***	*(H4)*
Group level												
Intercept	γ_{00}	2.96	.05	78	54.44	***	2.96	.05	78	54.44	***	
Sex ratio	γ_{01}	-.17	.16	77	-1.08		-.17	.16	77	-1.09		
Group size	γ_{02}	.04	.05	77	.67		.04	.05	.77	.65		
Autonomy	γ_{04}	.52	.11	77	4.91	***	.53	.11	77	4.93	***	*H3*
Intensity of Effort	γ_{06}	.47	.17	77	2.71	**	.47	.17	77	2.71	**	*H5*
Group autonomy as moderator												
CD(i) x Autonomy(g)	γ_{34}	-.32	.11	80	-2.85	**						*H6*
Random effects		VC		*Df*	X^2	Sign.	VC		*Df*	X^2	Sign.	
Intercept	u_{oj}	.13		72	156.10	***	.13		72	156.02	***	
Cognitive distance		.09		75	100.40	*	.11		76	108.63	**	
level-1	*R*	.35					.35					

[1] Final estimation of fixed effects (with robust standard errors).
[2] CD(i) means individual cognitive distance, and Aut(g) means group autonomy.

FIGURE 1

Group autonomy as Moderator of the Cognitive Distance – Knowledge Transfer Relationship



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