Small group learning: Do group members' implicit theories of ability make a difference?

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Abstract

We examined the impact of members' implicit theories of ability on group learning and the mediating role of several group process variables, such as goal-setting, effort attributions, and efficacy beliefs. Comparisons were between 15 groups with a strong incremental view on ability (high incremental theory groups), and 15 groups with a weak incremental view on ability (low incremental theory groups). Groups worked on a computer-based management simulation. The task required the groups to learn the underlying structure of the simulation to be able to control the system effectively. High incremental theory groups set more challenging group goals, attributed their performance more to effort, developed stronger group efficacy, and displayed steeper learning trajectories than low incremental theory groups. Group goals mediated the impact of group members' implicit theories on group learning. Exploratory analyses of the group communication process revealed that members of the high incremental theory groups communicated more openly about the task and maintained a stronger task focus compared with members of the low incremental theory groups. Research on group learning benefits from a stronger individual differences perspective that incorporates variables, such as implicit theories of ability, as determinants of emerging group processes and outcomes.

Keywords: implicit theories of ability; goal-setting; effort attributions; efficacy beliefs; small group learning

Small Group Learning: Do Group Members' Implicit Theories of Ability Make a Difference?

Most contemporary educational programs include some form of group learning, such as learning in project groups or on-line discussion groups. Educational settings that employ such group-based forms of instruction have been shown to consistently lead to better learning outcomes than settings that do not use group-based work. For instance, in a meta-analysis on the effects of social context on learning with computer technology, learning in small groups positively influenced both individual achievement and group task performance of students at primary, secondary and college level compared to learning in isolation (Lou, Abrami, & Apollonia, 2001).

In an effort to gain a better understanding of the factors that increase the effectiveness of groups, researchers have studied group composition and its impact on group processes and outcomes. Variables that have been investigated include demographic characteristics (e.g., age, gender, race) and their dispersion in groups (Mannix & Neale, 2005). Also of interest are group member competencies, such as teamwork skills and cognitive ability (Devine & Phillips, 2001; Kozlowski & Ilgen, 2006). More recently attention has turned to personality characteristics of group members. In particular, Big Five variables, such as conscientiousness, extraversion and agreeableness, have been shown to influence group outcomes (Bell, 2007; Kozlowski & Bell, 2003). In the current study we aim to extend this literature by examining the effect of an individual differences variable – implicit theories of ability – that has been linked to differential learning outcomes at the individual level in the educational literature (Dweck, 1999), but has not yet sufficiently been examined in terms of its group compositional effect. We are specifically interested in whether the amount of learning that occurs in a group differs for groups that differ in the implicit theories of their members.

In sum, this paper makes three contributions. First, it extends our understanding of the effect of group composition on adult learning in group-settings. In this regard, our study provides further evidence that the psychological characteristics that individuals bring to the group setting significantly influence group achievement by influencing the types of group processes that occur. Second, this paper contributes to the literature on implicit theories of ability in learning contexts, which to date has focused on the effects of implicit theories on individual learning. Our study is the first to investigate whether the individual-level findings generalise to learning in the context of groups. Third, this study provides preliminary insights into characteristics of the group communication process that might contribute to the differential group learning effect.

In the following sections we will first briefly characterize implicit theories of ability and then discuss the mechanisms through which group members' implicit theories might impact group learning.

1 Implicit Theories of Ability

Implicit theories of ability refer to individuals' beliefs in the relative fixedness versus the malleability of ability. According to Dweck (1999) entity theorists believe that human abilities are fixed and do not change with experience, training or other developmental experiences. In contrast, incremental theorists believe that human ability is constantly developing, adapting and changing in response to opportunities and situational demands. The simple belief about the degree to which human abilities are either fixed or able to be changed and developed has been found to influence learning and achievement in the domains to which the belief is applied (e.g., Good, Aronson, & Inzlicht, 2003; Henderson & Dweck, 1990; Stipeck & Gralinksi, 1996).

For example, Blackwell, Trzesniewski and Dweck (2007) found that implicit theories of ability were related to the trajectories of adolescents' math achievement over a two-year

period. Students who held incremental beliefs displayed stronger increase in math grades (controlled for prior achievement) relative to those who held entity beliefs. Experimental work with college students supports the conclusion that the facilitating effect of an incremental theory of ability also applies to adult learners. In one study college students, who were encouraged in an experiment to interpret ability as a malleable rather than as a fixed resource, obtained higher grade point averages (controlled for SAT scores) than their counterparts in two control groups (Aronson, Fried, & Good, 2002). This suggests that implicit theories of ability are an important antecedent of learning at secondary and post-secondary level.

In the current study we use a sample of college students who participate in a group learning exercise and examine the effect of group members' implicit theories of ability on group learning in a complex simulation-based task. Complex simulation-based tasks require learners to systematically explore the simulation and deduct the underlying rules that govern the system. For the reason that changes in performance across task trials are a direct result of the rules applied, in the current study performance trajectories (i.e., relative performance improvements over time) were considered a measure of learning.

To date, conclusions regarding the effects of implicit theories of ability on learning have been constrained to the individual level of analysis. Nevertheless, at least two indirect sources of evidence suggest that implicit theories of group members will impact group learning. First, at the individual level, implicit theories of ability have consistently been linked to learning in complex task environments (Bandura & Wood, 1989; Wood & Bandura, 1989). To the extent that individual characteristics of group members act as inputs into group processes that influence group outcomes (Kozlowski & Ilgen, 2006), the learning effect of implicit theories can also be expected to generalize to the group level. Second, several previous studies have reported positive findings for the effects of a related construct—group learning goal

orientation—on group task performance (e.g., Bunderson & Sutcliffe, 2003; DeShon, Koslowski, Schmidt, Milner, & Wiechmann, 2004). Implicit theories and goal orientation are related in that incremental theorists are more likely than entity theorists to frame tasks as learning opportunities and therefore are more likely to pursue learning goals (Payne, Youngcourt, & Beaubien, 2007). Consequently, one might also expect groups composed of incremental theorists to outperform groups of entity theorists.

2 Implicit Theories of Ability and Group Processing

Based on evidence from individual level research on implicit theories we assume that there are at least three mechanisms through which group members' implicit theories might impact group learning and consequently group performance, namely, group attributions, group efficacy and group goals. These constructs refer to the perceptions and beliefs that members share about the group as a whole (Bar-Tal, 1990) and which are formed as part of group discussions.

Group attributions refer to the explanations that groups agree and act on as the most likely causes of their performance when interpreting performance feedback (Weiner, 1986). Based on evidence for individual level effects of implicit theories (e.g., Ames & Archer, 1988; Dweck, 1999; Tabernero & Wood, 1999) we make the following assumptions. Attributions about group performance in groups composed of incremental theorists are more likely to focus on controllable factors, such as the effort exerted and the effectiveness of task strategies. When encountering setbacks and failure to achieve goals, groups of incremental theorists are less likely to interpret negative feedback as an indication of the group's lack of ability. In contrast, groups of entity theorists are likely to interpret problems, including their concerns about the group's capability, as immutable barriers to performance improvement.

Attributions impact learning by influencing persistence and strategy development. Attributions focused on constraints that are difficult to change, such as the basic capabilities

of the group members or fixed aspects of the task, will lead to the conclusion that developing and testing new strategies or working harder at the task will not work and are a waste of time. Experimentation is no guarantee of success but it often is a necessary condition for improvement in the early stages of work on novel and complex tasks. The tendency of incremental theorists to attribute performance to controllable factors is one reason why groups of incremental theorists are expected to learn more and to perform better than groups of entity theorists.

Group efficacy refers to the members' shared belief about their ability to perform effectively as a unit (Bandura, 1997). The way in which groups of incremental and entity theorists interpret feedback is likely to impact their efficacy beliefs. We expect that when encountering setbacks and failure to achieve goals, groups composed of incremental theorists will tend to stay focused on the task in their discussions. They are less likely to become engaged in prolonged meta-task analyses, such as elaborating constraints on their performance, which diverts attention from the task and weakens the perceived group efficacy for the task. In contrast, questioning of the group's capability to overcome barriers by entity theorists will lead to lower group efficacy.

Group efficacy, in turn, has been shown to be positively related to group *effectiveness* (Gully, Incalcaterra, Joshi, & Beaubien, 2002). The mediational paths through which group efficacy beliefs can influence group learning outcomes include the goals and strategies groups pursue, the strength of commitment to the task, how well members work together to produce results, and the resiliency of the group in the face of setbacks and difficulties (Bandura, 1997, p. 469). Hence we see group efficacy as another major reason as to why groups composed of incremental theorists are expected to learn more and to outperform groups of entity theorists.

Group goals refer to the level of difficulty of goals that group members set for the group when performing a task. Based on evidence from individual level research (Eliott &

Dweck, 1988) we expect that in a group composed of incremental theorists, group members are likely to suggest and agree to challenging goals, and to consider a range of alternative strategies for achieving these goals. In contrast, groups of entity theorists are more likely to set less challenging goals and choose less risky strategies as a means of avoiding later feedback that may provide evidence of failure.

Studies of group goal-setting have consistently shown a positive relationship between goal difficulty and task performance, thus replicating one of the commonly observed goal effects at the individual level (e.g., Mitchell, & Silver, 1990; Mulvey & Ribbens, 1999). Group goals can enhance group learning outcomes through their positive effects on group planning, group effort, group strategies and group cohesiveness as well as through their impacts on individual effort and adjustments of individual strategies to the group task (Smith, Locke, & Barry, 1990; Weldon & Weingart, 1993). Hence, we see group goal setting as a third major mechanism through which a group members' implicit theories impact group learning and performance.

In summary, we expect that

(1) groups composed of incremental theorists will display steeper learning trajectories than groups composed of entity theorists (learning hypothesis), and

(2) the impact of group composition on group learning will be mediated through the groups' attributions, efficacy beliefs and goal setting (mediation hypothesis).

We further expect differences between entity and incremental groups with regard to characteristics of the group communication process. Incremental theorists typically are expected to be more focused on the task and more willing to openly discuss task issues and alternative strategies when confronted with setbacks or substandard performance. For entity theorists, however, the threat of failure is more likely to result in them focusing on the

evaluative implications and they are less likely to want to talk about task issues, because it might reveal their lack of competency for the task (Dweck, 1999). Hence, we expect that

(3) groups of incremental theorists will communicate more openly in their task discussions as they are less concerned about evaluative implications than groups of entity theorists (communication hypothesis), and

(4) groups of incremental theorists will be more task focused in their discussions than groups of entity theorists (task focus hypothesis).

3 Method

3.1 Participants

Participants were 90 undergraduate psychology students between 21 and 27 years of age ($\bar{x}$ = 22.42, *SD* = 1.20), who were enrolled in a course on organizational behaviour at a Spanish University. The majority of students were female. Students participated in the study for course credit.

3.2 Experimental Task

The experimental task was a computer-based scenario, which required participants to manage employees of a small furniture production company over the period of 12 simulated weeks of business activity (see Wood & Bailey, 1985). The aim of the task was to minimize the time taken to produce weekly orders of furniture. Participants worked in groups of three. In each simulated week (i.e., trial) groups made managerial decisions (e.g., allocating certain tasks to individual employees) and received feedback on their performance, enabling them to learn from past decisions and to plan for subsequent decisions. Group performance in the management simulation was operationalized as the number of hours required for the production of each weekly order. This has been reversed in the reporting of results so that a higher score indicates better performance for ease of interpretation. Group learning was

operationalized via the relative increase in performance across the 12 trials (i.e., learning trajectories).

3.3 Procedure

Several weeks before students participated in the experimental task they completed the implicit theories of ability scale (Dweck, 1999). Based on their scores students were allocated to one of 30 groups according to the procedure described in section 3.5.

On the day of the experimental session, and prior to commencement, all groups received a demonstration of the computer-based management simulation and were asked to discuss how they expected to perform on this task. They then, as a group, were asked to fill in measures of attribution, efficacy beliefs and goal-setting. Then the groups worked for 6 trials on the management simulation (i.e., Block 1) before they again were asked to respond to the group attribution, efficacy and goal measures. These measures were administered for a third time after the second block of six trials. At each of the three assessment points, group assessments of attribution, efficacy beliefs and goal-setting were preceded by a self-managed group discussion in which group members discussed their reactions to the items until a decision was reached on the agreed responses. This routine is consistent with the group information processing approach in which group processes evolve from discussions of group performance and capabilities (Hinsz, Tinsdale, & Vollrath, 1997). Following the completion of the computer-based management simulation and the third round of group assessments, each participant responded individually to the group communication measure (Barry & Stewart, 1997). In order to obtain an estimate of group members' intellectual capabilities, the average academic grade of each participant (comparable to a GPA score) was also elicited.

3.4 Measures

Implicit Theories. The six items for the *implicit theories of ability* scale were taken from the measures developed and validated by Dweck and her coworkers (Dweck, 1999). We

slightly modified the wording to more closely reflect the managerial task (i.e., a management simulation) that groups were asked to tackle. For example, the original item "*You have a certain amount of ability, and you can't really do much to change it."* was modified such that ability was further specified as managerial ability (*"You have a certain amount of managerial ability, and you can't really do much to change it.").* The answer format was a 6-point Likert-type scale ranging from 1 = *"strongly disagree"* to 6 = *"strongly agree"*. The entity items were reverse scored and all items were averaged to create a single scale ($\alpha = .87$) with higher scores indicating a stronger incremental perspective on abilities and lower scores indicating a stronger entity perspective on abilities. Each participant completed this measure individually. The resulting scores were normally distributed (K-Smirnov $Z = .636$, $p = .813$).

Group attributions were collected using a forced choice approach in allocating a total of 10 points to four alternative explanations for the group's performance. One of these four explanations represented a controllable factor (effort), whereas the other three explanations represented uncontrollable factors (task difficulty, group ability, luck, see Weiner, 1986). The number of points allocated to effort as an attribution was used to operationalise controllability. This measure was completed by each group based on achieved consensus among group members.

Group efficacy was recorded on a nine-item efficacy scale. Each item described a level of performance in the simulation-based task relative to the standard level of performance on this task (e.g., *"10% better than standard performance"*). The standard level of performance (i.e., standard performance) in this task had been established through pilot testing, and was communicated to participants as part of the instruction. In other words, participants were informed about how well students typically perform on this task. Group members completed this measure as a group. They rated the strength of their perceived efficacy as a group to achieve each of the levels of performance described in these items. The ratings for each of

the nine items were made on 10-point scales ranging from 1 = *"no confidence at all"* to 10 = *"total confidence"*. The strength of perceived group efficacy was the mean of the confidence scores for the nine levels of performance. Internal consistency for the collective efficacy scores was high (α = .93, see also Table 1).

Group goals were recorded as the level of performance the group was aiming for in the succeeding trials of the management simulation. This measure was completed as a group effort. Groups selected their goal from nine levels of possible performance, plus one additional option stating "no goal". Each level of possible performance was described as performance relative to standard performance on the task (e.g., *"10% better than standard performance",* see description of the group efficacy measure). For ease of interpretation, the nine-level scale was subsequently transformed to represent the corresponding performance scores in the management simulation (i.e., number of hours required for the production of each weekly order). This has been reversed in the reporting of results so that a higher score indicates a more challenging goal.

Group communication. The subscales Task Focus (3 items), e.g., "*In group discussions we frequently drifted off the point*" (reverse scored), and Open Communication (4 items), e.g., *"All group members had a chance to express their opinions",* were taken from the Group Style Questionnaire developed and validated by Barry and Stewart (1997). Participants were asked to "*Evaluate how your group functioned while working on the task"* and to *"Circle the number that best represents your beliefs about your group and its activities while working on the task"*. Each participant completed this measure individually. Answers were on a 5-point scale with anchor statements, ranging from 1 = *"to a very little extent"* to 5 = *"to a very great extent"*. The internal consistency coefficients for both task focus (α = .90) and open communication (α = .80) were high and consistent with past research using these scales (Barry & Stewart, 1997).

3.5 Experimental factor

Based on individuals' responses to the implicit theory scale the 90 participants were allocated to 30 groups of three. In order to contrast performances from groups characterized by different implicit theories of ability the following procedure for establishing the experimental factor was adopted: Each of the 15 groups expected to represent an entity view on ability was composed of one individual from the lowest, one from the middle, and one from the highest tercile of participants *below* the median of the implicit theory scale. Each of the 15 groups expected to represent an incremental view on ability was composed of one individual from the lowest, one from the middle, and one from the highest tercile of participants *above* the median. This way we ensured that the different groups within a category (either incremental or entity) were relatively homogeneous with respect to their group composition, while maximizing the difference between the two group categories with regard to group members' implicit theories of ability. Note, using this procedure we do not make any assumptions with regard to the relative contribution of each group member to group processes and outcomes.[1]

The inspection of the distribution of the implicit theory scale (median = 4.45; $\overline{x}$ = 4.40, SD = .63, min = 2.36, max = 5.64) revealed that only a few participants could be classified as entity theorists based on their score on the implicit theory scale (note: scores below 3.5 would justify such a classification). Two possible explanations for this situation come to mind. First, this situation could give rise to the optimism that the overwhelming majority of university students adopt an incremental view on abilities. Another explanation, which is less sanguine, could be that in a learning environment (i.e., a university context) it might be socially desirable to hold an incremental view on ability, and this might have influenced students' responses to the implicit theory scale. At this point we cannot decide which explanation is more likely, whether there are other mechanisms, or whether a combination of them were at

play. What is clear, however, is that we in fact are comparing groups of individuals with low levels of incremental conceptions of ability with groups of individuals characterized by high levels of incremental conceptions of ability. We will refer to these groups as low incremental theory and high incremental theory groups. However, this poses a challenge to our ambition to demonstrate superior learning of groups composed of individuals who believe in the malleability rather than the fixedness of ability. While the initially stated hypotheses remain in place with regard to the direction of the expected effects, the likely consequence, however, is that the potential effects will be smaller and statistically harder to detect.

4 Results

Table 1 shows the correlations, means and standard deviations for the study variables. The first three panels of Figure 1 (from the left) show the levels of group effort attributions, efficacy and goals (controlled for group ability) for the low incremental and high incremental theory groups at each of the three assessments. ANCOVAs of the baseline measures of group effort attributions, $F(1,27) = 0.10$, $p = .757$, partial $\eta^2 = .004$, efficacy, $F(1,27) = 0.10$, $p = .750$, partial $\eta^2 = .004$ and goals, $F(1,27) = 1.43$, $p = .242$, partial $\eta^2 = .05$, which were taken before the groups had any direct experience on the task, showed that there were no differences between the low and high incremental theory groups, independently of group ability. Note, individual ability scores were averaged across group members to obtain group-level ability scores, which were included as a covariate in these analyses. This suggests that low and high incremental theory group members do not simply differ in their beliefs a priori.

Insert Table 1 about here

To assess the contribution of group members' implicit theories of ability to the group learning trajectories over the 12 trials of the task, we compared the learning trajectories of

groups with low incremental and high incremental theories of ability (learning hypothesis). A repeated measures ANCOVA was used in which group composition was a between subjects factor, trial was a repeated measures factor, and group ability was a covariate. In relation to the repeated measures factor, we defined a linear within-subjects trend contrast in order to examine the linear component of performance growth over the trials (see ANCOVA tests of within-subject contrasts), which we take as our operationalisation of learning. The learning hypothesis (hypothesis 1) was tested by examining the term from the ANCOVA that represents the interaction of group composition (the between-subjects factor) and the linear within-subjects trend contrast (i.e., the linear increases in performance). The interaction effect tests whether there are differences in the slope of learning trajectories for the high incremental theory versus low incremental theory groups. The learning hypothesis was fully supported. There was a statistically significant linear increase in performance across the 12 trials, $F(1,27) = 4.26$, $p < .05$, partial $\eta^2 = .14$. Furthermore, performance increased at a faster rate for high incremental theory groups than for low incremental theory groups, $F(1,27) = 11.18$, $p < .01$, partial $\eta^2 = .29$, suggesting that groups composed of high incremental theorists were better able to accurately develop and apply knowledge about the task they were working on. These results are depicted in the fourth panel of Figure 1.

Insert Figure 1 about here

The mediation hypothesis (hypothesis 2) was tested using a causal steps analysis followed by the Sobel Test of the mediation effect (see Baron & Kenny, 1986). Once again, group ability was controlled in all analyses. Specifically, we were interested in whether the effect of group composition on the outcome of learning (i.e., performance in the second block of six trials) was mediated by differences in group attributions, group efficacy-beliefs and

group goals that emerged after the first block of six trials in assessment phase 2. We conducted a mediation analysis of performance on the last six trials because: (1) these occurred after the process measures were collected, and (2) they represent the outcome of what groups had learned on the earlier trials (as evident from Figure 1, the performance of both groups started to stabilize after approximately six trials). Note, differences in performance between the two groups were statistically significant on Block 1, $F(1,27) = 5.88$, $p < .05$, partial $\eta^2 = .18$, and Block 2, $F(1,27) = 8.31$, $p < .01$, partial $\eta^2 = .24$.

We first examined the effects of group composition on each of the three group process variables at assessment phase 2. One-way ANCOVAs were used in which group composition was a between subjects factor and group ability was a covariate. Results indicated that the differences for group effort attributions and group efficacy were not significant at assessment phase 2. Statistically significant differences for effort attributions and efficacy only emerged at the third assessment, taken after Block 2, [effort attributions: $F(1,27) = 4.08$, $p = .05$, partial $\eta^2 = .13$; efficacy: $F(1,27) = 6.12$, $p < .05$, partial $\eta^2 = .19$].

However, with respect to goal setting, statistically significant differences did emerge at assessment phase 2. High incremental theory groups set higher goals than the low incremental theory groups, both, in the second assessment following Block 1, $F(1,27) = 11.60$, $p < .01$, partial $\eta^2 = .30$, and the third assessment following Block 2, $F(1,27) = 16.17$, $p < .01$, partial $\eta^2 = .38$. Consequently, the results for group goal setting met Baron and Kenny's (1986) first pre-condition for establishing mediation, $B_{xm} = 12.63$, $SE_{Bxm} = 3.71$, $p < .01$, whereas the results for group effort attributions and group efficacy did not. As a result, these variables were not considered further with respect to hypothesis 2.

The results for goal setting also satisfied Baron and Kenny's second and third conditions for mediation. Goal setting at the end of Block 1 was significantly related to performance in Block 2 when controlling for group ability and group composition ($B_{my.x} =$

0.99, $SE_{Bmy.x}$ = 0.26, $t(26) = 3.75$, $p < .01$), whereas the effect of group composition on Block 2 performance was no longer significant when ability and goal setting were controlled ($B_{xy.m}$ = 5.33, $SE_{Bxy.m}$ = 6.05, $t(26) = 0.88$, $p = .386$). Finally, the mediating effect of goal setting (B_{xm}*$B_{my.x}$ = 12.50), tested using the Sobel test, was statistically significant (*Sobel Z* = 2.53, $p < .05$). Consequently, the data are consistent with the hypothesis that goal setting after Block 1 mediates the relationship between implicit theories and Block 2 performance. High incremental theory groups tended to demonstrate better learning as evident by their superior task performance, because they set more challenging goals[2].

Hypotheses 3 and 4 predicted that high incremental theory groups would have more open communication and greater task focus, respectively, than low incremental theory groups. Both hypotheses were supported. Members of the high incremental theory groups were more likely to report that they openly expressed disagreements and stated their opinions when communicating about the task than members of the low incremental theory groups, $F(1,28) = 6.98$, $p < .05$, partial $\eta^2 = .20$. Group members' responses further suggested that high incremental theory groups were more focused on the task and able to use their time more effectively than low incremental theory groups, $F(1,28) = 4.95$, $p < .05$, partial $\eta^2 = .15$ (see also fifth panel in Figure 1).

5 Discussion

The present study investigated the effects of implicit beliefs about the malleability or fixedness of ability of college students on group learning and the pathways through which this effect takes place. Although the relationships between implicit theories of ability and variables including goal setting, effort attributions, efficacy and task performance have been studied at the individual level (e.g., Bandura & Wood, 1989; Wood & Bandura, 1989), the present study is, to our knowledge, the first to test whether such effects also occur at the group level.

Interestingly, in our sample only a few participants could be described as entity theorists based on their score on the implicit theory scale. The majority of participants indicated to have an at least somewhat incremental view on ability. We were interested in whether the degree to which group members indicated to believe in the malleability of ability differentially affected group processing and learning outcomes.

Groups composed of high incremental theorists benefitted more from the learning experience than their low incremental theorist counterparts. They set themselves more challenging goals and showed steeper learning curves than the groups composed of low incremental theorists. The differential goal setting of the low and high incremental theory groups became more pronounced the longer the groups worked on the task. Significant differences in the goal setting of the two types of groups were evident by the end of the first block of trials and mediated the effects of implicit theories on group learning. Group effort attribution and efficacy also increased over the duration of the task, however differences between the two groups on these variables developed more slowly than differences in goal setting, and did not reach significance until after Block 2. Neither of these variables mediated the effect of implicit theories on group learning.

At least three features of the current study help to clarify the nature of the effects. First, although the high incremental theory groups had higher ability scores than the low incremental theory groups, we were able to establish that the effects of implicit theories on group learning occurred independently of group ability level. That is, the strong belief that ability is malleable contributes to group learning even when group differences in ability are controlled for.

Second, the inclusion of multiple assessment points allowed us to capture the dynamic nature of the relationships. The lack of differences on the baseline assessments of the group process variables (i.e., goal setting, effort attribution and efficacy beliefs) suggests that the

effects of group members' implicit theories operate differentially through their responses to the task. That is, the effects evolve as part of the learning experience, including the feedback received during task completion, and are not simply due to different pre-existing beliefs associated with low or high incremental perspectives on ability.

Third, the large majority of participants in this study reported to hold – to at least some extent – an incremental view on ability. Using a quasi-experimental design, we were able to demonstrate that the *intensity* with which group members believed in the malleability of ability differentially affected the groups' responses to the task and ultimately their learning as a group. The observed beneficial effect on group learning of a high incremental view on ability as compared to a low incremental view on ability was large in size (partial $\eta^2 = .29$, see Richardson, 2011).

In sum, this study provides support for the notion that group members' conceptions about ability differentially affect their learning as a group. Furthermore, 'more is better' in this context: The stronger group members believed in the malleability of ability, the more they learned as a group.

The fact that we were not able to identify a significant number of entity theorists in our sample is interesting, as it suggests that the concept of entity theory might be less relevant in adult learning. Future studies should examine whether (a) this finding generalises to other samples of adult learners, and (b) whether entity theorists – once identified – and low incremental theorists differ significantly in their approaches to learning. The latter is important, as it is also possible that student responses were skewed toward incremental theory because of the social desirability of an incremental view on ability in higher education. Students, who indicated to only 'somewhat' believe in the malleability of ability might, in fact, hold entity beliefs. Therefore, they might not differ in their learning behavior from salient entity theorists. Note, in the current paper, and in line with Dweck (1999), we took a

one-dimensional approach to the study of implicit theories of ability. However, a two dimensional approach might be more appropriate in adult learning; it would allow recording and investigating learners' entity beliefs independent of their incremental beliefs.

This study shows that the differential and dynamic learning effect of implicit theories observed at the individual level generalizes to the group level. Given that our study was an initial endeavor to examine the effects of implicit theories of ability in groups, we restricted our design to groups that were homogeneous with respect to implicit theories. In natural settings one would, however, expect groups to present different proportions of low and high incremental / entity theorists. Future research is required to examine whether the beneficial effects of groups composed of purely high incremental theorists also occur when compared to more heterogeneous groups composed of both incremental and entity theorists. Note, however, before studying how groups of different combinations of implicit theorists will produce different learning outcomes, we needed to first establish that the individual differences variable implicit theories of ability does indeed have a (main) effect on group level processes and outcomes.

One preliminary implication of our findings is that the belief that abilities are malleable entities rather than fixed traits should be encouraged in study groups and other groups that are created to facilitate learning. Research at the individual level suggests that implicit theories of ability are indeed amenable to intervention, and that relatively small intervention programs can yield major gains in student achievement (Dweck, 2010), also emphasizing the dynamic nature of this effect.

The exploratory results for group communication processes extended the findings for group task responses by adding a measure of the intra-group behavioral processes that might have been expected to contribute to the different group responses to the task and the resulting performance levels. High incremental theory groups reported more open communications and

a stronger task focus than the low incremental theory groups. The stronger task focus by the high incremental theory groups is consistent with the finding that incremental theorists show greater tendency to focus on task strategies as explanations for performance, compared to entity theorists (Dweck & Leggett, 1988). The weaker task focus by the low incremental theory groups is consistent with the finding that entity theorists are more likely to adopt avoidance strategies when they encounter setbacks on challenging tasks (Dweck & Leggett, 1988). However, the post hoc measure of task focus was strongly related to group performance and therefore we cannot rule out the possibility that the observed difference was due to members' knowledge of the group's performance level[3].

A limitation of the current study is that we cannot specify the content of the behavioral processes through which the implicit theories of individual group members shaped group learning processes and outcomes. Direct observation of group behaviors is needed to provide more fine-grained analyses of group processes, such as time spent on problem analysis, strategy evaluation, and criteria definition. Finally, common to group studies, our sample may have lacked the power needed to obtain significant effects for the mediating role of group attributions and group efficacy.

Group culture sets the learning environment, for instance in terms of an incremental or entity view on learning, through the language used in evaluations and discussions of performance. This could also impact individual learning in peer groups, classrooms and other conditions where learning takes place in a social context. Future research on group learning would benefit from a stronger individual differences perspective, incorporating variables, such as implicit theories of group members, as determinants of the emerging group culture and examining the effects of group culture on group members' individual learning outcomes. Such studies are currently underway in our laboratory.

The present study contributes to the literature on the effects of group personality composition on group processes and outcomes. Although some progress has been made in identifying the personality variables that are antecedent to achievement in group settings (Kozlowski & Bell, 2003), the present study is, to our knowledge, the first to provide evidence that implicit theories of ability also represent one such antecedent. These findings are consistent with several previous studies that have reported beneficial effects of a learning goal orientation on group efficacy (e.g., DeShon et al., 2004) and group outcome variables (Bunderson & Sutcliffe, 2003). As implicit theories are generally considered antecedent to goal orientation (e.g., Payne, et al., 2007), it may be that learning goal orientation represents a more proximal link through which implicit theories influence group processes and group performance. However, group goal orientation seems to be unrelated to group goal setting (e.g., DeShon et al., 2004), which is the main pathway through which implicit theories influenced group performance in the present study. Consequently, there is reason to believe that the effects of implicit theories and goal orientation are at least partly independent.

The present findings also add to the body of studies analyzing group dynamics within a social-cognitive framework (Gibson, 1999; Prussia & Kinicki, 1996), which have shown that the impacts of personality structures on learning outcomes are mediated through the cognitive and affective responses to the task and performance feedback at both the individual and group levels. Some of these processes can be described in terms of similar mechanisms, such as goals, attributions, and efficacy, thus providing opportunities for linkages and the integration of results across the differing levels of analyses.

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Figure 1. Group effort attributions, group efficacy and group goals at assessment phases 1, 2 and 3, learning trajectories across trails 1 to 12, and open communication and task focus for low and high incremental theory groups.

9 Footnotes

[1] There are different ways how group-level implicit theories of ability could be operationalised, and each alternative has implications in terms of the interpretation of results. For instance, of the three group members' scores the most extreme score (i.e., the score of the member with the strongest entity/incremental view) could be chosen as a representative of the group. The implicit assumption would be that the person with the most extreme expression of an entity/incremental view would have the strongest impact on group processes and outcomes. Similarly, using the average score (across the three group members) implies that all three group members contribute equally to group processes and outcomes (i.e., their score has the same weight). By simply categorizing groups as either entity or incremental we do not make such assumptions. However, the disadvantage of this procedure is the loss of variability (which might be systematic or error variability).

[2] Note, (1) findings remained unchanged when gender and age were included in the analyses as control variables. (2) We have also used path analysis to test hypothesis 2 with similar findings that lead to the same conclusions (direct effect of group composition on group goal setting: $\beta = .58$, $p = .002$, direct effect of group goal setting on group performance in Block 2: $\beta = .34$, $p = .049$; Indirect effect of group composition on group performance in Block 2: $\beta = .13$, $p = .395$). In addition, the effect of group efficacy on Block 2 group performance was also significant in this model ($\beta = .49$, $p = .005$).

[3] The lack of a significant relationship between open communication and group performance may well be due to the structured nature of the task options and the fact that the task provided little opportunity for the presentation and evaluation of new options. Open communication processes may contribute more directly to performance on tasks that are less structured and require greater creativity in the inputs of group members. On the positive side,

this result does suggest that differences in the reports of open communication within the groups were not a product of the knowledge of the group's performance level.

Table 1: Correlation Matrix, Means and Standard Deviations for all Study Group-Level Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Ability[1]	-												
2	Group Composition	.42*	-											
	Baseline													
3	Effort Attribution	.03	.07	-										
4	Efficacy	.15	.12	-.24	(.93)									
5	Goal Difficulty	.12	.25	-.13	.51**	-								
	Block 1													
6	Performance	-.19	.30	-.12	.11	.12	-							
7	Effort Attribution	.03	.31	.44*	-.01	-.09	.44*	-						
8	Efficacy	-.07	.27	-.19	.47**	.09	.74**	.49**	(.94)					
9	Goal Difficulty	-.26	.37*	-.14	.32	.31	.70**	.22	.58**	-				
	Block 2													
10	Performance	-.09	.40*	-.15	.16	.11	.97**[2]	.41*	.76**	.70**	-			
11	Effort Attribution	.12	.38*	.56**	-.05	-.03	.26	.90**	.33	.16	.23	-		
12	Efficacy	-.04	.37*	-.19	.39*	.04	.75**	.48**	.95**	.61**	.77**	.35	(.96)	
13	Goal Difficulty	-.26	.43*	.17	.07	.14	.56**	.31	.43	.65**	.52**	.44*	.54**	-
Total Groups														
Mean		1.72	4.26	3.80	5.56	102.33	108.57	4.17	7.25	119.00	118.08	4.33	7.60	122.77
SD		.21	.51	1.03	1.51	9.35	10.95	1.66	1.78	11.02	16.96	1.80	1.93	17.72
Entity Groups														
Mean		1.64	3.94	3.73	5.38	100.00	105.36	3.67	6.78	115.00	111.37	3.67	6.89	115.33
SD		.20	.34	.88	1.51	9.26	14.82	1.40	2.20	11.80	22.27	1.40	2.37	12.88
Incremental Groups														
Mean		1.81	4.59	3.87	5.73	104.67	111.80	4.67	7.72	123.00	124.79	5.00	8.31	130.20
SD		.21	.44	1.19	1.54	9.16	2.58	1.79	1.11	8.82	1.78	1.96	1.01	19.12

Note: *$p < .05$, **$p < .01$, $N = 30$ groups. [1]For the correlation analyses the individual ability scores have been averaged across group members to obtain group-level ability scores. [2]This very high correlation is due to one group that performed low on both occasions and created a high leverage point. However, there is a strong correlation ($r = .61$) between both performance scores even if this group is excluded from the analyses. Also, excluding this group from other analyses did not change any of the results.

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Figure 1