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LOGAN M. STEELE
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EXPLORATION AND EXPLOITATION EFFORT AS MEDIATORS BETWEEN STATE-LEVEL GOAL ORIENTATION AND COMPLEX PERFORMANCE

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DEPARTMENT OF PSYCHOLOGY

BY

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Dr. Michael D. Mumford, Chair

____
Dr. Eric A. Day

____
Dr. Hairong Song

____
Dr. Jennifer Barnes

____
Dr. Shane Connelly

____
Dr. Jeffrey Schmidt

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Abstract

Organizational success depends on a workforce that can effectively solving the problems posed by rapid changes in modern marketplaces. In this study, we use achievement goal theory and self-regulation theories to better understand the mechanisms by which people solve complex problems. We hypothesized that the effects of goal orientations on performance would be mediated by exploratory effort and exploitative effort. These hypotheses were tested using a sample of 119 undergraduate students. Participants completed multiple sessions of an experimental task — an adaptation of the *marshmallow challenge* (Wujec, 2010) — that required people to create a useful structure with a novel design. The results of this study showed that exploration effort positively related to novelty, and exploitation effort positively related to usefulness. Mastery-approach goal orientation was a significant predictor of both types of effort, while performance-approach goal orientation led to increased exploitation effort and decreased exploration effort.

Introduction

The extraordinary rate of change in modern technology has put high demands on today's workforce to effectively adapt. Successful adaptation requires people to solve new and unfamiliar problems (Pulakos, Arad, Donovan, & Plamondon, 2000). In other words, adaptation is a form of complex problem-solving (Mumford, Baughman, Threlfall, Uhlman, & Costanza, 1993). Of course, by nature, complex problems have the potential to be solved by any number and variety of solutions. Perhaps the most effective course of action in response to a given change is a minor tweak in an extant strategy. Or, perhaps what is most effective is combining two unrelated strategies into a brand new approach. Whatever the case, problem solvers must find a way to manage these twin goals of novelty and usefulness (Amabile, 1996; Berg, 2014; Litchfield, 2008; Mumford & Gustafson, 1988). In the present study, we apply a multiple-goal pursuit framework (Kernan & Lord, 1990; Vancouver, 2008) to the case of complex problem solving. We propose that goal orientation influences how people manage this multiple-goal context, and we argue that the effects of goal orientations on performance can be explained by how people allocate resources toward either exploration of new strategies or exploitation of known strategies.

Multiple-Goal Pursuit

Managing the pursuit of multiple goals simultaneously is the norm in everyday life, both within and outside of the workplace (Unsworth, Yeo, & Beck, 2014). Because people have limited resources, both physically and psychologically, the pursuit of one goal often means that no or little progress is being made towards another goal. Thus, a focus of recent research has been on understanding how people make decisions about and prioritize goals in a multiple-goal context (e.g., Ballard, Yeo, Loft, Vancouver, & Neal, 2016; Schmidt, Dollis, & Tolli, 2009; Vancouver, Weinhardt, & Schmidt, 2010). Within this context, a number of variables have been studied to predict behavior, the most prolific of which are goal orientations.

Goal orientation refers to the way in which one approaches a goal in an achievement setting (Ames, 1992; Elliot & McGregor, 2001). This multidimensional construct is typically broken down into three factors (Payne, Youngcourt, & Beaubien, 2007; Vandewalle, 1997). Mastery-approach goal orientation (MGO) refers to an approach that focuses on mastering a task and understanding the relevant content. Performance-approach goal orientation (PGO) reflects a focus on proving one's high level of competence to others and striving to do better than others. Finally, performance-avoid goal orientation refers to a focus on avoiding performing worse than others. Similar to others (e.g., Chen & Mathieu, 2008; Miron-Spektor & Beenen, 2015), in the present study, we examined the effects of MGO and PGO, excluding performance-avoid goal orientation due to its consistent, negative relationship with various performance outcomes (Hulleman, Schrager, Bodmann, & Harackiewicz, 2010; Payne et al., 2007). Furthermore, the focus of this study was on how approach solving a complex problem, rather than avoiding failure or appearing incompetent.

Goal Orientation → Effort

Previous research has identified several mechanisms through which goal orientations influence performance. MGO, for example, has been shown to affects performance through increased absorption in a task (Elliot & Harackiewicz, 1994), deeper processing of information (Grant & Dweck, 2003), and longer retention of information (Bell & Kozlowski, 2008). PGO has been linked to similar adaptive strategies such as task absorption (Elliot & Harckiewicz, 1994) and persistence (Grant & Dweck, 2003); however, PGO is also associated with shallow processing of information (Elliot et al., 1999) and higher levels of anxiety when being evaluated (Huang, 2011). Thus, while MGO shows a consistently positive relationship with performance, this is not true of PGO (Hulleman et al., 2010; Payne et al., 2007). Interestingly, higher levels of MGO and PGO have both been associated with increased levels of effort (Elliot et al., 1999). However, intensity of effort is just one of three dimensions that explains motivation (Pinder, 2008). In addition to intensity and persistence, motivation refers to the *direction* in which effort is expended (Pinder, 2008). Self-regulation theories describe effort as being how motivational variables (e.g., goal orientation) translate into action (Johnson, Chang, & Lord, 2006; Kanfer, 1992; Lord, Diefendorff, Schmidt, & Hall, 2010; Vancouver, 2008) or where the "rubber meets the road." In the present study, we address this gap in the literature by examining the relationships between goal orientation and the directions in which resources (i.e., effort) are allocated.

Broadly speaking, a *problem* is a situation in which a person has a goal but does not know how to reach that goal (Duncker, 1945). Without a known solution, the solver must search for information that will aid her in identifying a strategy that will close the gap between the desired state and actual state (Austin & Vancouver, 1996). People can go about learning to solve a problem in one of two ways: exploitation or exploration (Mehlhorn et al., 2015). Mehlhorn and colleagues (2015) suggest that these learning strategies exist on a three-part continuum. First, exploration and exploitation differ in the extent to which one remains at one option over time (exploitation) or switches between options (exploration). For example, an instructor might utilize one pedagogical technique to teach (e.g., lecture), or he could try multiple pedagogical techniques (e.g., lecture, discussion, role play). Second, exploration and exploitation differ with respect to the values and uncertainty associated with choice options. That is, exploration involves choices with low subjective values and high uncertainty, while exploitation involves choices with high subjective values and low uncertainty. For instance, when eating at a new restaurant, a diner can choose an option similar to her favorite dish at her regular eatery, or she could try a brand new dish. Third, exploration and exploitation differ in that exploitation offers rewards, while exploration offers information. Returning to the previous example, the diner will likely enjoy a dish similar to her favorite one, but trying a new dish could provide new insight into her culinary preferences.

Importantly, both learning strategies present the problem solver with tradeoffs. In the following sections, we argue that the tendency to choose to explore or exploit are, in part, a function of their goal orientations.

Mastery-Approach Goal Orientation → Effort

Previous research on MGO has consistently shown a positive relationship with “deep learning” strategies (e.g., Payne et al., 2007; Pintrich, 2000; Sujan, Weitz, & Kumar, 1994), such as integrating new information with existing knowledge and thinking about the implications of newly acquired information. This focus on acquiring information reflects a strong link between MGO and exploratory processes (Bell & Kozlowski, 2002, 2008). Furthermore, MGO has been associated with intrinsic motivation (Hulleman et al., 2010; Rawsthorne & Elliot, 1999), which reflects an interest in and enjoyment of an activity for the sake of the activity itself (Deci, 1971; Deci & Ryan, 1985). Higher levels of interest in an activity, in turn, predict exploratory actions (Berlyne, 1971; Kashdan & Silvia, 2009; Steele, McIntosh, & Higgs, 2017).

Although MGO has traditionally been linked to exploratory self-regulatory processes (Alexander & Van Knippenberg, 2014), there is evidence to suggest it will also be positively related to exploitative processes. For example, previous research has shown that MGO predicts persistence (Bandura & Wood, 1989; Elliot, McGregor, & Gable, 1999) and metacognition (Bell & Kozlowski, 2008; Ford, Smith, Weissbein, Gully, & Salas, 1998; Schmidt & Ford, 2003), both of which, we argue, are primarily exploitative processes. As described earlier, Mehlhorn and colleagues (2015) conceive of exploitation as learning behaviors that seek to maximize the rewards obtained from a confined set of options. Persistence, defined as allocating effort towards a defined goal despite boredom or failure (Elliot et al., 1999), reflects a decision to remain committed to an extant strategy with the expectation that rewards will eventually be reaped. With the focus of this behavior being less concerned with information and more with rewards, we argue that it bears a stronger similarity to exploitation than exploration. With respect to metacognition, this refers to a process of monitoring and controlling goal-directed behaviors (Koriat, Ma’ayan, & Nussinson, 2006). The process of evaluating one’s performance and making refinements (Ford et al., 1998), again, reflects a decision to commit to an extant strategy (i.e., exploit). Nevertheless, making refinements to existing strategies will likely require experimentation with new approaches (i.e., exploration). This suggests that while solving complex problems, people will constantly alternate between exploratory and exploitative strategies (March, 1991; Mehlhorn et al., 2015). Indeed, we expect that MGO will be positively related to the effort people devote to both strategies.

Hypothesis 1: Mastery-approach goal orientation is positively related to (a) exploration effort and (b) exploitation effort.

Performance-Approach Goal Orientation → Effort

In contrast to MGO, PGO exhibits less consistent relationships with learning strategies and performance outcomes. Rather than "deep learning" strategies, PGO tends to be associated with "surface learning" strategies (Elliot et al., 1999), such as rote memorization (Zimmerman & Pons, 1986). Although PGO is modestly related to job performance ($\rho = .11$; Payne et al., 2007) and achievement generally ($\rho = .06$; Hulleman et al., 2010), it is unrelated to other important criteria such as learning and task performance (Cellar et al., 2011; Payne et al., 2007). Since PGO reflects a focus on outperforming others and demonstrating one's competence (Pintrich, 2000), we argue that it is likely to be associated with exploitative processes. A concern for appearance will drive people to pursue outcomes they are more certain they can reach and to do so by a means with which they are familiar. Both of these attributes reflect an exploitative strategy (Mehlhorn et al., 2015).

Hypothesis 2: Performance-approach goal orientation is positively related to exploitation effort.

Given that a person's attentional resources are limited (Kanfer & Ackerman, 1989), an emphasis on one strategy will necessarily reduce the resources available for pursuing another strategy. Thus, higher levels of PGO may be negatively related to exploration effort due to the focus of resources on exploitation. Unlike MGO, PGO does not present the problem solver with a rationale for pursuing both exploration and exploitation strategies. If the objective of exploration is to acquire information, PGO would only be expected to have a positive relationship with exploration if it could offer the opportunity to demonstrate one's competence. This is seldom the case, though. For demonstrating one's competence, a much more efficient strategy is to capitalize on that which is known to be successful. Nevertheless, one context in which PGO may positively relate to exploration is when the performance criterion demands novelty. In this case, adhering to a routine solution is guaranteed to fall short of the performance standards. Out of concern for demonstrating one's competence in producing a novel solution, someone with a higher PGO may be prompted to devote effort to exploration. Given these competing predictions, we chose to treat the nature of the relationship between PGO and exploration effort as a research question.

Research Question 1: What effect does performance-approach goal orientation have on exploration effort?

Effort → Performance

As noted previously, when faced with an ill-defined and complex problem, the solver must generate solutions that are both novel and useful (Amabile, 1996; Mumford & Gustafson, 1988). We argue that the extent to which a given solution is novel or useful will depend on the learning strategies (i.e., exploratory or exploitative) a person employs. Generating novel ideas inherently depends heavily on learning because old solutions based on extant knowledge will not solve new problems (Song & Montoya-Weiss, 1998). Thus, acquiring new information and testing new strategies is critical.

Furthermore, previous research has shown that original ideas frequently emerge from combining distal areas of knowledge (Gilson, Lim, D'Innocenzo, & Moye, 2012; Mumford, Baughman, Supinski, & Maher, 1996; Simonton, 2003). Acquiring new knowledge and identifying novel associations between concepts requires resources to be devoted to exploration, and these demands for exploration increase as the desired originality for an idea increases (Madjar, Greenberg, & Chen, 2011). Exploration, however, brings with it uncertainty and an increased risk of failure (March, 1991; Mehlhorn et al., 2015). Exploitation, on the other hand, builds on past successes, making it much more likely to experience early rewards (March, 1991; Mehlhorn et al., 2015). Incremental changes to an existing strategy, while more useful in the short-term, necessarily restrict originality (Berg, 2014).

Hypothesis 3: Exploration effort is (a) positively related to product novelty and (b) negatively related to product usefulness.

Hypothesis 4: Exploitation effort is (a) positively related to product usefulness and (b) negatively related to product novelty.

Goal Orientation → Effort → Performance

Theories of self-regulation (Carver & Scheier, 1998; Karoly, 1993; Powers, 1973; Vancouver, 2008) suggest that during goal pursuit, people direct and modify their attentional resources to achieve the desired end state (DeShon & Gillespie, 2005). Thus, we expect that the effects of goal orientations on performance will be mediated by exploration and exploitation effort. More specifically, we expect that MGO will have a positive indirect effect on product novelty and usefulness through exploration and exploitation effort, respectively. And, PGO will have a positive indirect on product usefulness and negative indirect effect on product novelty through exploitation effort.

Hypothesis 5: Exploration and exploitation effort mediates the relationship between goal orientation and performance.

Level of Analysis

Previous research on goal orientations has identified that their effects vary when examined across levels of analysis (e.g., Beck & Schmidt, 2013; Payne et al., 2007; Yeo, Loft, Xiao, & Kiewitz, 2009). In studies of other motivational variables (e.g., self-efficacy), relationships can change not only in magnitude, but also in direction when the levels of analysis are separated (e.g., Sitzmann & Yeo, 2013; Vancouver, Thompson, & Williams, 2001). Thus, in the present study, we isolated the between- and within-person sources of variance (Chen, Bliese, & Mathieu, 2005; Dalal, Bhave, & Fiset, 2014; Raudenbush & Bryk, 2002).

Method

Sample Description

Participants were 125 undergraduate students attending a large, public university in the southwestern United States. The data for six participants were either missing due to computer problems or removed from the final dataset for not following the study proctor's instructions. The final sample consisted of 119 participants (79 female), whose age ranged from 18 to 42 (*M* = 19.8, *SD* = 3.8). Students received research credit for an introductory psychology course for participating in this study.

Experimental Task

The task was an adaptation of Wujec's (2010) "marshmallow challenge." In this task, participants are given a time limit within which they must build a freestanding structure with the provided materials. Furthermore, at the top of this structure, participants must place a whole marshmallow. In five trials, participants were asked to build a freestanding structure in nine minutes with the following materials: 20 pieces of 12-in pipe cleaners, 36 inches of tape, 36 inches of string, and one marshmallow. Before each trial, instructions were read which informed participants that performance on their structures would be evaluated in terms of height and the extent to which their design and use of materials was original.

Measures

Performance

Performance was evaluated with respect to two dimensions — usefulness and novelty (Amabile, 1996; Runco & Jaeger, 2012). Usefulness was operationalized as the height of the top of the marshmallow. Height was used as a criterion because it was an indicator of the extent to which participants provided an "appropriate, useful, correct, or valuable response to the task at hand" (Amabile, 1996; p. 35). Height was measured by the study proctor using a yardstick. After the expiration of each trial's time limit, the proctor waited 15 seconds to take the measurement to ensure that the structure was indeed freestanding, rather than being supported by the participant.

Novelty was operationalized as the extent to which the structure's overall design and use of materials are unique or uncommon. Novelty was evaluated by three independent judges (Amabile, 1982). Pictures of each structure were taken and stored in such a way that blinded the judges to the experimental conditions. Intraclass correlation coefficients (ICCs) were used to assess interrater reliability (Shrout & Fleiss, 1979). The interrater agreement for novelty was good (Cicchetti, 1994), ranging between .65 and .84 (M = .74, SD = .06). The ratings of all three raters were averaged to produce a novelty score.

Exploration and Exploitation Effort

After each trial, two types of effort were measured: exploitation effort and exploration effort. To minimize fatigue, two items were used to assess each type. Participants responded on a scale from 0 (*not at all*) to 10 (*extremely hard*). Scores for both items were averaged to create a single exploitation effort and exploration effort score for each trial. Exploitation effort was measured with the following items: "How hard did you try to get the highest scores possible in the previous trial?" and "How hard did you try to focus on doing what you are best at in this task during the previous trial?" Internal consistency ranged from $\alpha = .75$ to $\alpha = .91$ (M = .84, SD = .05). Exploration effort was measured with the following items: "How hard did you try to better understand the task during the previous trial?" and "How hard did you try to experiment with different strategies and techniques during the previous trial?" Internal consistency ranged from $\alpha = .54$ to $\alpha = .84$ (M = .73, SD = .08).

Goal Orientation

Before each trial, participants' levels of PGO and MGO were assessed. Again, to minimize fatigue due to repeated measures, two items were used for each type of goal orientation. Both scales were drawn from Yeo et al. (2009), who originally adapted them from Horvarth, Scheu, and DeShon (2004). Participants rated the extent to which they agreed with each statement on a scale of 1 (*strongly disagree*) to 5 (*strongly agree*). The two performance-approach items were "At the moment, it is important to me to perform better in this task than others" and "At the moment, I want others to recognize that I am one of the best at this task." Scores on these items were averaged to create one score for each trial. Internal consistency ranged from $\alpha = .70$ to $\alpha = .86$ ($M = .78$, $SD = .05$). The two MGO items were "At the moment, the opportunity to extend the range of my abilities during this task is important to me" and "At the moment, the opportunity to learn new things during this task is important to me." A score for each trial was calculating an average. Internal consistency ranged from $\alpha = .76$ to $\alpha = .91$ ($M = .85$, $SD = .04$).

Procedure

Participants completed this study one at a time in order to avoid confounds due to observing others' structures. Next, the proctor read aloud instructions describing the marshmallow challenge task and how performance would be evaluated. The proctor also explained that participants who earn above-average scores would be entered in a drawing to win a $25 Amazon.com gift card. To incentivize engagement during each trial in the study, participants earned an entry into the drawing for each trial in which their scores were above average. Thus, a participant could have up to five entries in the drawing. After this explanation of the nature of the task, participants completed the goal orientation measures. Next, participants executed the first trial. Once time expired for the first trial, the proctor measured the height of the structure, took a picture of the structure, then replenished the materials for the second trial. Meanwhile, participants completed measures of their effort for the first trial and measures of their goal orientation levels for the second trial. This pattern continued through the five trials (see Figure 2).

Analysis

Multilevel path analysis was implemented using Mplus version 6.12 (Muthén & Muthén, 1998-2012). In addition to accounting for the nesting of observations within persons, using a multilevel analysis allowed us to model separately between- and within-person effects. This is important because, as noted earlier, the magnitude and directionality of effects can change across levels (e.g., Vancouver et al., 2001), and this extends to mediation effects also (e.g., Beck & Schmidt, 2013). As suggested by Preacher, Zyphur, and Zhang (2010), within-person variables were centered at the within-person level. That is, level-1 predictor variables (i.e., effort and goal orientation) were centered by first averaging each participants' scores. Then, participants' mean scores were subtracted from their individual observations.

Results

Descriptive Statistics

Table 1 provides a summary of descriptive statistics of all study variables and bivariate correlations at the between- and within-person levels. The ICC(1) values indicate that substantial within-person variability was present in all level-1 variables, particularly for the two performance variables.

Hypothesis Tests

Model Overview

A summary of the path model tested in this study is provided in Figure 3. All reported values are standardized multilevel path coefficients. At the within-person level of analysis, the effects of time are controlled for on state goal orientations, effort, and performance. In addition, correlations at the within- and between-person levels are modeled between the goal orientation variables, effort variables, and performance variables.

Hypothesis 1: MGO → Exploration and Exploitation Effort

Hypothesis 1 stated that MGO would be positively related to exploration and exploitation effort. As shown in Figure 3, this hypothesis was supported at both the within- and between-person levels of analysis. This indicates that at a given point in time, people who experience higher MGO than they usually do are more likely to exert effort towards exploiting their strengths, as well as towards exploring new strategies. Furthermore, these results suggests that people who generally have a higher level of MGO will exert more effort towards both exploitation and exploration. Thus, H1a and H1b were supported.

Hypothesis 2: PGO → Exploitation effort

Hypothesis 2 stated that PGO would be positively related to exploitation effort. This hypothesis was supported at the between-level of analysis, but not at the within-person level (see Figure 3). This indicates that people who have higher levels of PGO in general will typically devote more resources toward exploitation. However, when people have a higher level of PGO relative to what is typical for them, this does not necessarily lead to more exploitation effort.

Research Question 1: PGO → Exploration Effort

Research Question 1 asked what effect PGO would have on exploration effort. The evidence regarding this relationship was mixed (see Figure 3). At the between-person level, a non-significant, positive effect was observed, and at the within-person level, a significant, negative effect was observed. Thus, at a given time, people with a stronger PGO, relative to their usual state, are likely to devote slightly fewer resources towards exploration.

Hypothesis 3: Exploration Effort → Novelty and Usefulness

Hypothesis 3 stated that exploration effort would be positively related to product novelty and negatively related to product usefulness. With respect to novelty, exploration effort was positively related at both the within- and between-levels of analysis; however, only the within-person effect was statistically significant (see Figure 3). With respect to usefulness, this pattern flips — that is, the effect of exploration effort is non-significant at the within-person level, but at the between-person level, this effect is marginally significant ($p < .10$) and negative. These results show that at a given time, someone who directs more effort than usual towards exploration is more likely to produce a novel product. This comes with a tradeoff, though, because people who generally devote more resources than others toward exploration create less useful products.

Hypothesis 4: Exploitation Effort → Novelty and Usefulness

Hypothesis 4 stated that exploitation effort would be negatively related to product novelty and positively related to product usefulness. The results do not support the first component of this hypothesis. That is, at the between-person level, although trending in the expected direction, the effect is not statistically significant. And, at the within-person level the effect is positive and non-significant. With respect to usefulness, however, the hypothesis is supported. At the between- and within-person levels, effort devoted toward exploitation leads to more useful products being developed.

Hypothesis 5: MGO and PGO → Effort → Performance

Hypothesis 5 stated that the effects of MGO and PGO on performance outcomes (i.e., novelty and usefulness) would be mediated by exploration and exploitation effort. Indirect effects were calculated by multiplying the relevant path coefficients show in Figure 2. The indirect effects were estimated at both the within- and between-person levels. Confidence intervals around these indirect effects were computed using the PRODCLIN method developed by MacKinnon, Fritz, Williams, and Lockwood (2007). In contrast to more traditional methods (e.g., Sobel tests), the PRODCLIN method accounts for asymmetric distributions of indirect effects and, by doing so, produces more accurate significance tests. As shown in Table 2, the effects of MGO on usefulness, but not novelty, were mediated by exploration and exploitation effort at the between-person level. At the within-person level, MGO had a positive effect on novelty via exploration effort, while PGO had a negative effect. None of the other indirect effects were statistically significant.

In addition to testing the indirect effects of MGO and PGO on performance via effort, the direct effects of goal orientation on performance were examined. The results of this analysis are shown in Figure 4. No direct effects were statistically significant, but at the within-person level the effect of PGO on novelty was marginally significant.

Discussion

In the present study, we investigated the between- and within-person effects of goal orientations on complex performance. This study added a growing body of literature on multilevel approaches to understanding motivation by using a multidimensional assessment of performance (i.e., novelty and usefulness) and examining two broad learning strategies as (i.e., exploration and exploitation) as mediators in the relationship between goal orientations and performance. The results of this study show that MGO significantly predicts exploration and exploitation effort at both levels of analysis. PGO, on the other hand, significantly predicts exploitation effort only at the between-person level of analysis. These findings generally provide support for the first two hypotheses.

With respect to PGO's impact on exploration effort, our investigation of this relationship was framed as a research question due to competing hypotheses. Indeed, our results reflect these competing hypotheses by showing opposite effects across the two levels of analysis, although the path model coefficient was not statistically significant at the between-person level. Thus, people who generally report stronger PGO do not necessarily devote more effort toward exploration than those who report weaker PGO. However, if PGO increases above an individual's average, that person will allocate fewer resources toward exploring, which, consequently, will diminish the originality of the products they develop.

As was expected, the more a person devoted resources towards exploration, the more likely that person was to develop a novel product. The existence of a link between exploration and novelty has frequently been theorized in earlier work (e.g., Alexander & van Knippenberg 2014), but to date, a direct test of this relationship had not been conducted. It is worth noting that, although positive in both cases, this effect was statistically significant only at the within-person level. This suggests that original products are more likely to be produced when a concerted effort is made towards exploration. In contrast, high levels of exploration effort on average do not significantly predict product novelty. Higher average levels of exploration effort do, however, have a modest negative relationship with the average usefulness of products, which highlights the tradeoffs highlighted throughout this study. These tradeoffs seem to not apply as severely to exploitation effort. That is, exploitation effort is positively related to product usefulness at the between- and within-person levels, and it is non-significantly related to product novelty. Thus, exploitation effort may be able to enhance the usefulness of a product without simultaneously compromising its novelty (Berg, 2014).

These findings have important implications regarding the relationships between resource allocation, goal orientations, and their performance outcomes. For instance, MGO was consistently a stronger predictor of both exploration and exploitation effort than PGO, and these effort variables mediated the effects of MGO. This provides some support for Alexander and van Knippenberg's (2014) proposition that higher MGO makes it more likely that novel and useful ideas will be produced. It is noteworthy, though, that these effects are significant only at the within-person level. What this suggests is that trait-level differences in MGO will add less value to organizations than state-level differences. Dragoni (2005) demonstrated that leaders can foster different forms of goal orientation in their followers by the psychological climate they create. For example, to increase followers' state MGO, Dragoni (2005) shows that leaders emphasize employee development and encourage experimentation.

Given the positive effects, both in terms of product novelty and usefulness, that result from MGO, a question emerges about whether PGO adds any value, or if this form of goal orientation is maladaptive. Based on the results of the present study, one potentially adaptive use for increasing state PGO, is that it will reduce exploration (Steele et al., 2017). A context in which this is desirable is one in which resources are particularly strained (e.g., a short product development cycle) and, consequently, failure is less tolerable. Another adaptive function of less exploration is the increased probability of small wins. Having success early on can help gain buy-in from key stakeholders (Amabile & Pratt, 2016; Weick, 1984), but the likelihood of this success is threatened by an orientation more concerned with information and learning than rewards and results.

As the complexity of a problem increases, so do the amount of resources that can be devoted to exploration (Kanfer & Ackerman, 1989; Lejarraga, Hertwig, & Gonzalez, 2012; Rakow & Newell, 2010). Exploration, however, can have diminishing returns (Dar-Nimrod, Rawn, Lehman, & Schwartz, 2009), and this point of diminishing returns may not be readily apparent to the problem solver (Misuraca & Teuscher, 2013). Thus, promoting a PGO (e.g., by providing an occasional reminder of a deadline or the opportunity for earning a reward) may provide an adaptive reduction in exploration effort. This would be an interesting avenue for future research. In a previous study along these lines, Berg (2014) found that a product could be made more useful if problem solvers were asked to incorporate a common item into their final idea. For example, people who were asked to come up with a new product for a school bookstore were encouraged to incorporate a 3-ring binder into their final product idea. The cognitive and motivational mechanisms through which this occurs remains a question to be investigated in future research.

Other potential directions for future research could be in addressing some of the key limitations in the present study. First, the task we used has limited external validity. The materials participants used and the very short timeframe within which they had to create a product are not likely to reflect a field setting. Nevertheless, this task offered us several benefits, many of which have been mentioned in other studies of this kind (e.g., Gino, Argote, Miron-Spektor, & Todorova, 2010; Miron-Spektor & Beenen, 2015). One advantage to using this task was the balance it struck between too simple, so as to restrict the number of solutions possible, and too complex, so as to demand more time and prohibit repeated observations. Furthermore, that multiple solutions were possible and at least one viable solution was feasible (i.e., 99% of participants made a freestanding structure), enabled us to observe differences in how people would differentially allocate resources toward exploration and exploitation. Future research should examine the generalizability of these findings.

Another limitation was that we did not manipulate participants' goal orientation; therefore, we cannot rule out the presence of a third variable causing goal orientation and effort. Furthermore, although the causal order of our model is grounded in a deep body of research, without manipulating goal orientation, it cannot be definitively shown that it is goal orientation causing effort and not the reverse. It is plausible that these relationships are in fact bidirectional. For example, the process of pursuing mastery goals through exploration may enhance MGO by exposing a person to information that one finds interesting (Hulleman et al., 2010; Rawsthorne & Elliot, 1999). The nature of causality with respect to goal orientations and effort would be an interesting direction for future research.

Finally, this study focused on problem-solving processes of individuals, but new product development more often takes place in a team context (Hülsheger, Anderson, & Salgado, 2009). Individuals, rather than teams, were used in this study to control for potential confounds, such as being influenced by others' goal orientations and social loafing, but given that working in teams is the reality of most organizations, future research using this context would be useful. Teams, for example, offer the opportunity to specialize. Whereas in this study, individuals tended to devote resources to both exploring and exploiting, in teams, different units could be devoted to emphasizing different strategies (Gupta, Smith, & Shalley, 2006).

Conclusion

Solving complex problems is of paramount importance in organizations, and, consequently, so is the mechanism by which people do so. In this study, we adopted a multilevel approach to disambiguate the between- and within-person effects of state-level goal orientations on the novelty and usefulness of products people developed over multiple trials. The results indicated that exploratory and exploitative effort help to explain how MGO positively impacts novelty and usefulness, while PGO negatively impacts novelty by reducing exploration effort.

Table 1. Descriptive Statistics, Bivariate Correlations, and Intraclass Correlations

	Variable	Mean	SD	ICC(1)	1	2	3	4	5	6
1	Explore Effort	7.63	1.59	.40		.42***	.14***	-.11**	.15***	.12**
2	Exploit Effort	8.06	1.71	.52	.84***		.08†	.02	.10*	.19***
3	State MGO	2.67	0.82	.62	.48***	.46***		.13**	.01	.02
4	State PGO	3.73	0.67	.71	.14	.27**	.24**		.06	-.05
5	Novelty	2.40	0.51	.09	.03	.01	.06	.10		.14***
6	Usefulness	7.06	2.82	.14	.01	.18*	.09	.21*	-.17†	

Note. Between-person correlations are reported below the diagonal and within-person correlations are reported above the diagonal. For the between-person level of analysis, N = 119; for the within-person level of analysis, n = 595. ICC(1) = intraclass correlations; MGO = mastery-approach goal orientation; PGO = performance-approach goal orientation.
†*p* < .10. **p* < .05. ***p* < .01. ****p* < .001.

Table 2. Tests of Indirect Effects

Variable	Indirect Effects	95% Confidence Intervals	
		Lower Bound	Upper Bound
Between-person effects			
MGO → Explore Effort → Novelty	.079	-.105	.272
MGO → Explore Effort → Usefulness	-.212†	-.451	.001
MGO → Exploit Effort → Novelty	-.058	-.230	.104
MGO → Exploit Effort → Usefulness	.182†	-.004	.399
PGO → Exploit Effort → Usefulness	.072†	-.009	.202
PGO → Exploit Effort → Novelty	-.002	-.111	.045
PGO → Explore Effort → Usefulness	-.001	-.101	.075
PGO → Explore Effort → Novelty	.003	-.040	.054
Within-person effects			
MGO → Explore Effort → Novelty	.022*	.007	.043
MGO → Explore Effort → Usefulness	.008	-.006	.024
MGO → Exploit Effort → Novelty	.003	-.004	.013
MGO → Exploit Effort → Usefulness	.007†	-.001	.020
PGO → Exploit Effort → Usefulness	.002	-.001	.012
PGO → Exploit Effort → Novelty	.001	-.004	.007
PGO → Explore Effort → Usefulness	-.001	-.019	.005
PGO → Explore Effort → Novelty	-.016*	-.035	-.003

Note. MGO = mastery-approach goal orientation; PGO = performance-approach goal orientation.
†$p < .10$. *$p < .05$.

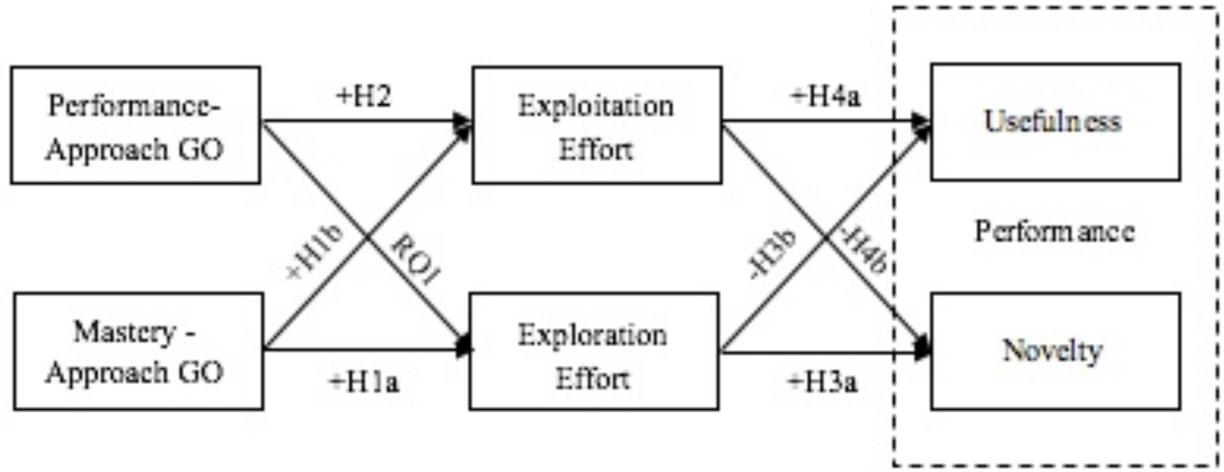

Figure 1. Summary of Hypotheses

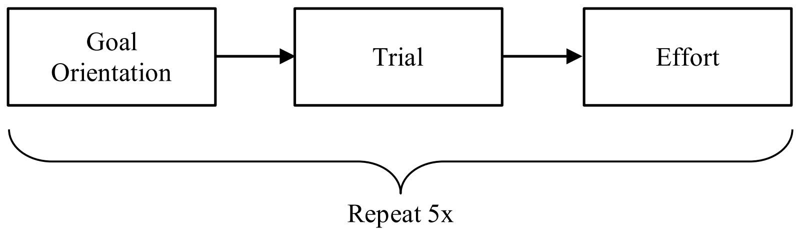

Figure 2. Study Procedure

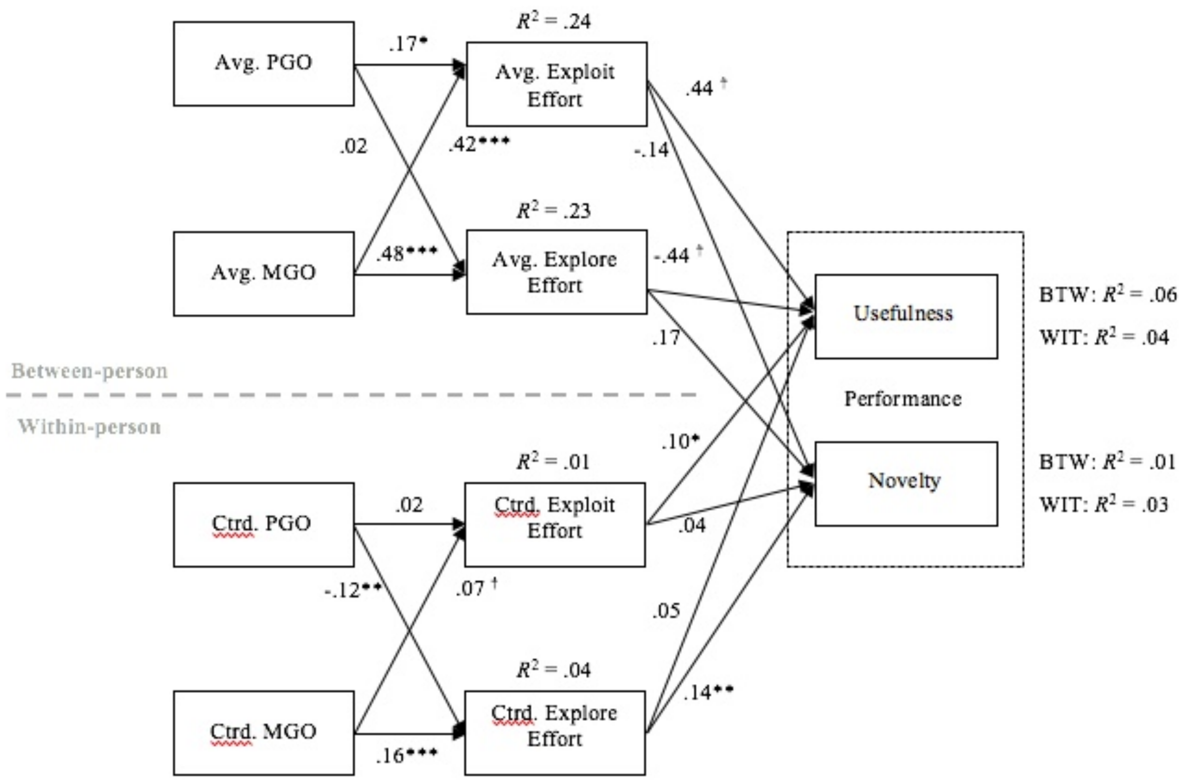

Figure 3. Summary of Multilevel Modeling Results
Summary of multilevel path modeling results. Coefficients are standardized multilevel regression weights. MGO = mastery-approach goal orientation; PGO = performance-approach goal orientation. Correlations between goal orientation variables and between exploitation and exploration effort at the between- and within-person levels were modeled but not shown here. The effects of time on level-1 variables are controlled for at the within-person level of analysis.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

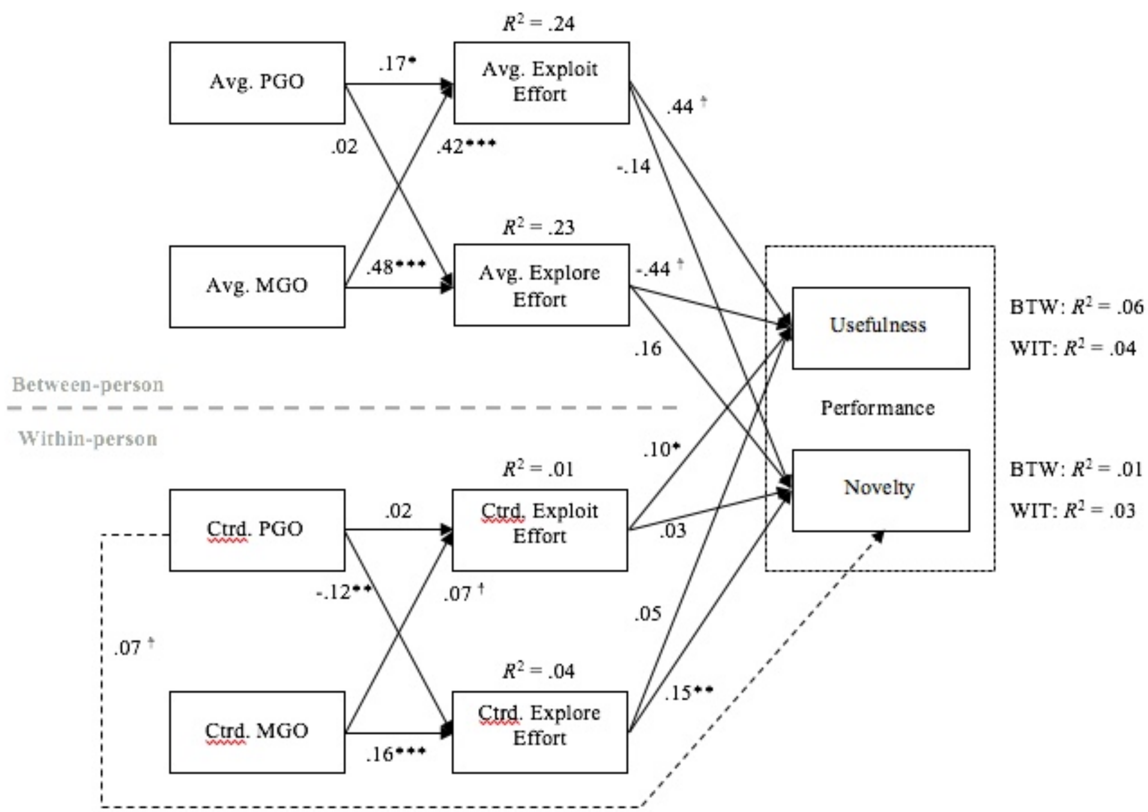

Figure 4. Summary of Multilevel Path Modeling Results with Statistically Significant Direct Effects
Coefficients are standardized multilevel regression weights. MGO = mastery-approach goal orientation; PGO = performance-approach goal orientation. Correlations between goal orientation variables and between exploitation and exploration effort at the between- and within-person levels were modeled but not shown here. The effects of time on level-1 variables are controlled for at the within-person level of analysis.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

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