The Role of Goal Orientation in Enhancing Adaptability by Using Serious Gaming

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Abstract

This study examined whether goal orientation can predict one's adaptability and cognitive flexibility – a constituent of adaptability. Furthermore, it was examined whether the effects of adaptability training could be predicted by one's goal orientation. In this training, adaptability was addressed by using the cognitive flexibility as constituent. Studying these relations was important because today's work environments require individuals to become more adaptive in performing their tasks, as fast advancing technology has increased the complexity of the environments and puts great demand on individuals. Despite of this need of adaptability, relations between constructs were still unclear and empirical evidence on training adaptability was lacking. The study was part of a larger study using an experimental between-subjects design. Data was analyzed from 81 participants assigned to the experimental (n=41) or control condition (n=40) playing a serious game. This game consisted of three scenarios containing rich narratives for ill-structured complex decision making. During the game-play, participants were guided by learning guidance consisting of reflective questions and prioritization assignments. The game-play was divided into two parts, being five to fourteen days apart. Furthermore, questionnaires were used to assess multiple concepts, including that of goal orientation, adaptability, and cognitive flexibility. Besides this self-assessment, cognitive flexibility was assessed by multiple cognitive tasks (IGT, WCST, and modified Balloon Task). Results were promising as cognitive flexibility and adaptability were predicted by mastery orientation, and that mastery orientation could be used as a predictor for all the adaptability dimensions except for physical adaptability. However, no correlation was found between goal orientation and the effect of adaptability training – addressing the constituent of cognitive flexibility. Therefore, self-assessed adaptability could be predicted by one's goal orientation, but performance on adaptability training could not. Implications for theory, limitations, and future directions are further discussed.

Introduction

Today's work environments require individuals to become more adaptive in performing their tasks, as fast advancing technology has increased the complexity of the environment and puts great demand on individuals. The advancing technology and automation of work procedures continue to alter the nature of work tasks, requiring individuals to learn different ways to cope with their work environments and deal with novel situations and problems (Bohle Carbonell, Stalmeijer, Könings, Segers, & van Merriënboer, 2014; Pulakos, Arad, Donovan, & Plamondon, 2000; Smith, Ford, & Kozlowski, 1997). Furthermore, mergers and restructuring of organizations require individuals to be adaptive to different working environments, using knowledge and skills in another context (Kozlowski et al., 2001; Pulakos et al., 2000). Within a global economy, cooperation with foreign companies requires individuals to operate effectively with individuals who possess different thoughts and values (Pulakos et al., 2000). An example of a work environment prone to these factors of uncertainty is that of NASA. Often by working together with other (foreign) organizations, new technology is continuously applied to ascertain the safety of astronauts and to support them in their tasks in space. This also implies that astronauts have to be able to apply new knowledge of tasks using this technology. Furthermore, if technology breaks down, they have to be creative with their resources and might need to use knowledge and skills in another context to prevent a potential disaster from occurring (Balthazard & Cooke, 2004). Despite the importance of adaptability in work environments, the concept of adaptability and its constructs involved are not entirely clear yet, and empirical evidence on training adaptability is lacking (Pulakos et al., 2000).

A construct that is possibly related to adaptability is goal orientation. The dispositional trait of goal orientation is the framework of one's interpretation and reaction to events or outcomes created by goals set by themselves. Several constructs that are known to be related to adaptability also relate to goal orientation. This possible connection between the two constructs could be important to explain the effects of adaptability training, as this orientation determines one's approach to reach a goal. Different orientations may lead to different ways of coping with the continuously changing work environments. This could reflect on one's adaptability and on the effectiveness of adaptability training.

Because of the possible effect of goal orientation on adaptability and its training, the present study focused on whether – and if so, how – the dispositional trait of goal orientation can be related to, and possibly predict adaptability, its interdependent concept of cognitive flexibility, and performance on adaptability training. If the training performance differs

between goal orientations, this research could contribute to the development of adaptability training by conducting research on differences between goal orientations.

Adaptability and cognitive flexibility

Adaptability can be defined as the ability of an individual to effectively anticipate, identify and interpret unexpected changes, and timely respond to those changes in such a manner that optimal performance is achieved (’t Hart, Dekkers, Kamphuis, Sassen, & de Vries, 2016). As complexity and demands of work environments increase, adaptability is required to cope with the uncertainty of these environments. An individual cannot solely rely on organizational structures and trained routines when having to respond to those changes. When fully relying on the robustness of structures and routines, it would be difficult to meet the new demands of a changing situation. That is why individuals need to switch between robustness and a more open-minded approach towards these situations. By being open to adjusting those learned structures and trained routines in changing situations, individuals react more autonomously enabling themselves to react to the unfamiliarity more easily. The interaction between robustness and being open-minded is what makes an individual adaptive (’t Hart et al., 2016; Bohle Carbonell et al., 2014). Thus, adaptability is the ability to realize a dynamic equilibrium between structure and making autonomous decisions based on the situation. An example that shows the importance of this equilibrium is the work situation during the launch of the *Challenger*. The uncertainty of how the launching technology would operate in cold weather should have alarmed the engineers and managers to abort the mission, but they together decided to stick with the launching routines, with all the consequences entailed (Boin & van Eeten, 2013).

There are two theories on how adaptability develops. Dawis and Lofquist (1976) proposed that individuals become more adaptive when being exposed to many different activities, involving different people, or when developing new ways of executing an activity (Dawis & Lofquist, 1976; Griffin & Hesketh, 2003). In addition, Smith, Ford, and Kozlowski (1997), and Chi (2011) stated that practice in performing complex tasks enhances adaptability because of the development of knowledge structures and metacognitive skills. Knowledge structures are the relations made among concepts of an individual and metacognitive skills are skills enabling an individual to monitor one’s thinking process (Chi, 1978; Martinez, 2006). Together, these structures and skills allow for an in-depth understanding of a task and the possibility to act on changing situational demands, as new experiences can explicitly be related to knowledge obtained from prior (un)related experiences (Cañas, Fajardo, &

Salmerón, 2006; Chi, 2011; Smith et al., 1997). What both theories have in common is that gaining knowledge through experiences provides individuals with an in-depth understanding, making it possible to transfer their knowledge and skills to new situations, thus to being adaptive (Chi, 2011).

The construct of adaptability is used as an aggregate of certain aspects of an individual, including personality traits, competencies, learning styles, and cognitive aspects. A dispositional construct that constitutes a cognitive aspect of adaptability is that of cognitive flexibility (Good, 2014). Cognitive flexibility can be defined as "the ability to spontaneously restructure one's knowledge, in many ways, in adaptive response to radically changing situational demands (Spiro & Jehng, 1990, p. 165)." In other words, it is the ability to adapt cognitive processing strategies to act on new and unfamiliar situations (Cañas, Quesada, Antolí, & Fajardo, 2003). This focus on unforeseen situational changes is what relates cognitive flexibility to adaptability.

Cañas et al. (2006) explained cognitive flexibility using three characteristics. The first characteristic is that cognitive flexibility involves a bottom-up learning process. People tend to learn from experience. The second characteristic is the change of cognitive processing strategies, which refers to a concatenation of actions taken to act upon a task or situation. Therefore, cognitive flexibility does not refer to changes in a specific response, but to changes of complex behaviors. Because these behaviors consist of several actions, it is possible for individuals to act adaptively without having to abandon the knowledge structures they have already built through experience. Knowledge can be restructured by relating new information to prior knowledge. The last characteristic of cognitive flexibility is that practice is needed before an individual can adapt to a new and unforeseen situation (Cañas et al., 2006).

Based on these characteristics and the definition of cognitive flexibility explained, the present study views cognitive flexibility as a construct that overlaps with adaptability to a large extent, indicating that it can predict one's adaptability. It can be seen as the cognitive aspect interdependent to adaptability which enables individuals to behave adaptively, as they will struggle to effectively anticipate, identify, and interpret (un)expected changes if failing to meet one or more of the characteristics regarding cognitive flexibility. Despite cognitive flexibility being a dispositional trait, this study views that individuals can be trained to use this trait more efficiently and effectively to a certain extent. Therefore, by providing training, they can be trained to be more cognitively flexible within the boundaries of the trait.

Self-efficacy and metacognition

The constructs of adaptability and cognitive flexibility are assumed to be related to self-efficacy (e.g., Griffin & Hesketh, 2003; Kozlowski et al., 2001; Martin & Rubin, 1995). Self-efficacy can be defined as the perceived capability of performing a task. It is a dynamic construct that changes over time when new information is obtained and experiences are acquired (Gist & Mitchell, 1992). This information and experiences influence confidence in one's capability to accomplish a task successfully (Chen, Thomas, & Wallace, 2005). Moreover, what relates self-efficacy to adaptability and cognitive flexibility is that it reflects on the construction and arranging of adaptive behavior to fit changing situations. Self-efficacy provides individuals with the confidence to deviate from familiar structures and routines when necessary, enhancing their cognitive flexibility (Gist & Mitchell, 1992). Therefore, individuals with the same set of skills can still act differently upon situational changes due to the differences in – the confidence of – combining and sequencing those skills, and utilizing them in different manners (Gist & Mitchell, 1992). Furthermore, Ford et al. (1998) found that a high self-efficacy mediates a better performance on tasks requiring adaptability. It makes people more resilient when facing a challenging and complex task, and motivates them to face greater task complexity (Ford et al., 1998; Hughes et al., 2013).

A construct related to adaptability that influences self-efficacy is metacognition (Ford et al., 1998). Metacognition can be defined as the monitoring and control of thought (Flavell, 1971; Martinez, 2006). It includes planning, monitoring, and the revision of goal appropriate behavior. Individuals with better metacognitive skills may therefore learn more effectively and be more adaptive, as they monitor their functioning within a situation enabling them to adjust their behavior according to situational changes (Ford et al., 1998). These skills are gained by experience, trying to set goals to achieve understanding, and find ways to reach those goals and evaluating one's progress (Flavell, 1971). This is in line with Chi (2011) who argues that adaptability is enhanced by the development of knowledge structures and metacognitive skills, allowing an in-depth understanding of tasks and the possibility of individuals to act on changing situational demands (Chi, 2011; Griffin & Hesketh, 2003; Smith, Ford, & Kozlowski, 1997).

Goal orientation

A construct that is related to self-efficacy and metacognition – like adaptability and cognitive flexibility – is goal orientation. As mentioned, goal orientation is the framework of one's interpretation and reaction to events or outcomes created by goals set by themselves. These

goals are based on two types of orientation: *performance orientation* and *mastery orientation*, making goal orientation a two-dimensional construct (Button, Mathieu, & Zajac, 1996). Performance-oriented individuals strive to demonstrate their competence via task performance to gain a favorable judgment on their competence from others or they try to avoid negative judgements on their competence, whereas those who are mastery-orientated focus on increasing competence to master something new regardless of what others might think (Button et al., 1996; Dweck, 1986; Kozlowski et al., 2001). One's goal orientation influences the ability to use obtained knowledge in another context. For instance, when performance-oriented individuals perform poorly, they will see no need in putting more effort into the task or in changing task strategy because they view the outcomes as a reflection of their ability, whereas individuals who are mastery-oriented tend to view a poor performance as a moment of feedback to alter their strategy and put more effort into the task (Gist & Stevens, 1998; Stevens & Gist, 1997). For this reason, mastery-oriented learning is believed to lead to better metacognitive skills and higher self-efficacy (Ford et al., 1998; Kozlowski et al., 2001).

Performance-oriented individuals maximize their performance focusing on a narrow set of surface characteristics sufficient for only basic declarative knowledge, such as learning the basic chess moves (Kozlowski et al., 2001). This will only result in a superficial comprehension of the task domain, preventing attention to more detailed principles, and inhibiting comprehension and knowledge integration. In the example of the superficial comprehension of chess moves, performance-oriented individuals would not be able to respond to unexpected moves of one's opponent. The superficial – but often still sufficient to complete a task – declarative knowledge of these individuals may limit the development of self-efficacy when failing to reach performance goals (Kozlowski et al., 2001). In contrast, mastery-oriented individuals focus on mastering the knowledge and skills needed for a task, which stimulates a self-regulated focus on an in-depth understanding of task concepts and relations (Gist & Stevens, 1998). Mastery-oriented goals encourage individuals to explore complex relations, be comfortable with making mistakes, and learn from those mistakes. This promotes the development of a consistent organization of key task concepts, better metacognitive skills, and task-specific efficacy (Ford et al., 1998; Kozlowski et al., 2001). Therefore, performance orientation is associated with low self-efficacy, whereas a mastery orientation is associated with high self-efficacy (Ford et al., 1998; Stevens & Gist, 1997). This is also the reason for mastery-oriented individuals to be more resilient towards mistakes or setbacks (Chiaburu & Marinova, 2005). They will see this as a learning opportunity that

motivates themselves to practice and improve, whereas performance-oriented individuals would more likely perceive themselves as unable to perform competently (Stevens & Gist, 1997). Although, what must be noted is that despite goal orientation being a two-dimensional trait, it is possible to possess both types of orientation as an individual can simultaneously strive to improve one's skills and to perform well compared to others (Button et al., 1996). For example, astronauts train to conduct their mission as smoothly as possible, but also to outperform other space agencies by being the first to conduct such a mission.

The present study

In the present study, a serious game was used to train adaptability by addressing the constituent of cognitive flexibility (see Mun et al., 2016). A serious game is a game with the purpose not solely to entertain, but also to educate and train (Alvarez & Djaouti, 2011). In this game, individuals were exposed to rule changes to train cognitive flexibility. Training with rule changes is assumed to enhance the adaptability, as cognitive flexibility is a constituent of this construct (LePine, Colquitt, & Erez, 2000). To extend the effectiveness of the game-play, the traditional focus on declarative knowledge and its related learning principles – such as reinforcement and overlearning – had to be expanded to a way of learning that allows learners to think like an expert while developing domain expertise (Borders, Polander, Klein, & Wright, 2015; Kozlowski et al., 2001). By this, constructs such as structure of knowledge and self-efficacy were addressed, which are constructs related to cognitive flexibility and adaptability (Kraiger, Ford, & Salas, 1993). This was done by developing guidance inspired by the ShadowBox method of Klein, Hintze and Saab (2013) and embedding this guidance into the game training. This method addresses more than just declarative knowledge which makes it suitable for complex domains where personnel must manage uncertainty, ambiguity, shifting goals, time pressures and ill-defined tasks – thus adaptability (Borders et al., 2015; Klein et al., 2013; Pulakos et al., 2000). It primarily focused on letting novices reflect on their training by comparing their learning and development of expertise to that of subject matter experts (Borders et al., 2015). Combining the serious game with the guidance inspired by the ShadowBox method formed the foundation of the adaptability training conducted in this study investigating the role of goal orientation on adaptability. It was used to test whether goal orientation can predict the effectiveness of training cognitive flexibility as a constituent of adaptability.

The research question whether goal orientation can predict one's cognitive flexibility and adaptability was based on the notion that goal orientation influences the ability to use

learned knowledge in another context and that it is related to self-efficacy and metacognition – like cognitive flexibility and adaptability (see figure 1) (e.g., Crawford, Schlager, Toyama, Riel, & Vahey, 2005; Gallagher & Prestwich, 2013; Kozlowski et al., 2001; Martin & Rubin, 1995; Smith et al., 1997; Stevens & Gist, 1997). However, research on these interrelationships and interdependencies of concepts is still lacking. If found by the present study that goal orientation predicts one's adaptability and cognitive flexibility, it would become possible to map adaptability in work environments by using the construct of goal orientation. It is expected that mastery-oriented individuals are more adaptive compared to their performance-oriented counterparts. If this appears to be true, it would become possible to improve training of adaptability taking into consideration one's goal orientation.

Investigating this predictability was done according to two hypotheses. The first hypothesis is that goal orientation predicts cognitive flexibility and adaptability. This is based on the inclination of mastery-oriented individuals to learn from challenging conditions – e.g. by using trial-and-error – which will help them to gain knowledge and skills from experience, evaluate situational changes, and to adapt if necessary (Gist & Stevens, 1998; Kozlowski et al., 2001). To answer this hypothesis, both cognitive flexibility and adaptability were assessed using questionnaires. Secondly, it is hypothesized that goal orientation predicts the benefits of adaptability training, such as a faster anticipation to situational changes. These benefits are expected to show in the in-game performance addressing the constituent of cognitive flexibility and in the performance on cognitive flexibility tasks. This hypothesis is based on the assumption that adaptability training in this study serves to provide individuals with the opportunity to gain experience with anticipating on changing situations to become adaptive (Schmidt & Bjork, 1992), as they were exposed to situational rule changes within the training's game scenarios. The second hypothesis can be split into two parts: (1) profoundly mastery-oriented individuals being more receptive to this training due to their way of mastering the required knowledge and skill – as explained by Gist and Stevens (1998) – which will lead to a better performance on both the game and tasks; and (2) individuals who are to a larger extent performance-oriented will be less receptive to the learning opportunities because they tend to focus on maximizing the performance alone, resulting in only a superficial understanding (Kozlowski et al., 2001).

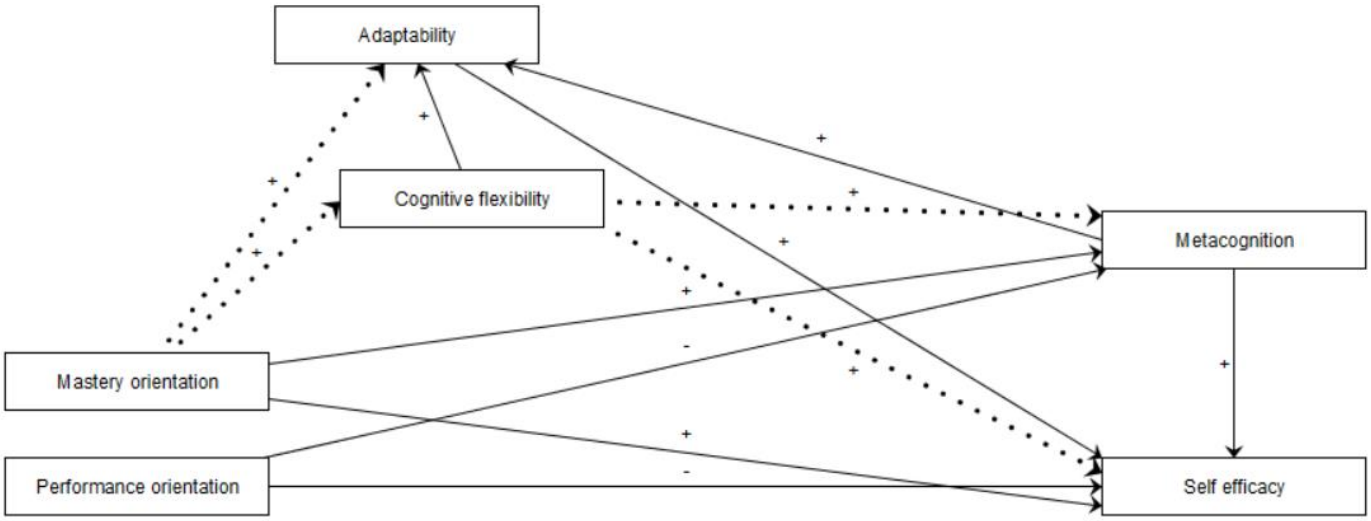

Figure 1. Conceptual structure of constructs: relations and expected relations.

Method

Participants

Due to the general and exploratory character of this study convenience sampling was used, taking students as the participant sample. In total, 86 participants – mainly undergraduate psychology students of the University of Twente – took part in the study in exchange for course credits or €40. The participants were recruited using an online participant-pool. Four participants had to be excluded from analyses due to procedural flaws (e.g., handing participants an assignment of the wrong condition) and one participant did not attend the second part of the study without providing a reason. The remaining 81 participants (25 males, 56 females) had a mean age of 20.69 (SD=2.23), with the age ranging from 16 to 29 years. The participants were randomly assigned to the experimental (n=41, 13 males, 28 females) or control condition (n=40, 12 males, 28 females). The study was approved by the ethics committee of the Faculty of Behavioral Sciences of the University of Twente.

Materials

The game scenarios. The game consisted of two PC-based training scenarios (S1 and S2) and one paper-based test scenario (TS), all containing rich narratives for ill-structured complex decision making. The contexts of the scenarios were a robot threat (S1), the development of a nano-vaccine against a super-virus (S2), and border control (TS). Fictitious contexts were chosen to avoid prior knowledge interfering on the topic. The training scenarios in this study were improved versions of the scenarios constructed by Mun et al. (2016). The test scenario was newly developed for this study, following the same principles as the training scenarios.

All scenarios consisted of 21 cases divided into three main components; the learning phase, consolidation phase, and the test phase. Every case consisted of four actions of which the participants had to choose two. This way, the participants could get to know the rules of the scenario in an active manner, feeling in control of the presented situation. After choosing two actions, the participants were provided with feedback on their choices. During the learning phase, participants learned three rules that are crucial to make decisions in the scenario by solving nine cases. Then, during the consolidation phase, participants confirmed whether they mastered the rules by answering a case for every rule. If not, this phase acted as an extra opportunity to do so. The consolidation phase was followed by the test phase. In this phase, the rules changed – for the experimental group – due to an event naturally introduced in the scenario. They were aware of this event, but would have to discover how this affected the rules by solving the following nine cases and by processing the feedback of the actions chosen within these cases. For the control group, no rule change was introduced during the two training scenarios (Mun et al., 2016).

In interest of the larger study, the test scenario was used as a measure to test whether participants had learned from the exposure to rule changes in the previous scenarios. This scenario contained a rule change for both the experimental and the control group. For the present study, the test scenario was treated as an extra training opportunity to cope with rule changes, as only the experimental condition – exposed to these changes throughout the entire study – was taken into consideration. The three scenarios were designed with increasing difficulty to maximize learning.

Learning guidance. To provide participants with an extra learning opportunity, they were provided with learning guidance on rule learning and rule change complementary to playing the game. After the learning and the test phase, participants had to answer open questions regarding the situation and rules they had familiarized themselves with. These reflective questions were from great importance to internalize the rule, as appeared from the study of Mun et al., (2016).

Besides reflective questions, guiding assignments were developed based on the ShadowBox method of Klein, Hintze, & Saab (2013). In this assignment, a case was presented in which participants had to prioritize four possible actions according to their suitability. The suitability of the actions was based on the rules applying to the situation of the scenario. By letting participants give reasons why they prioritized the actions the way they did, they would embody their understanding of the rules. After this, participants received the

answers, which subject matter experts would give on the assignment to compare and write down the differences. This way, participants were provided with guidance without explicitly mentioning the initial and changed rules. The prioritization assignments were given after the reflective questions of the learning phase and the test phase of the training scenarios. For the test scenario, the assignment was given only after the reflective questions of the test phase and without the comparison of expert answers, as at this moment of the study the focus was primarily on measuring the effect of the training. The prioritization assignments including the answers given by experts can be found in appendix B.

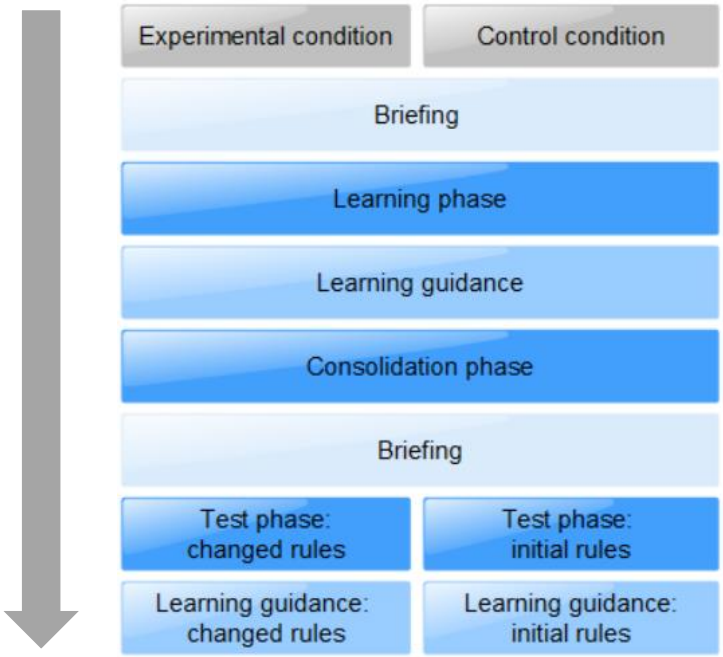

Figure 2. Training scenario structure.

Design

This study was part of a larger study that used an experimental between-subjects design in which participants were randomly assigned to one of the conditions – being either the control or experimental condition. In the experimental condition, participants were exposed to rule change in the two training scenarios as well as in the test scenario of the game, whereas the control condition was exposed to a rule change in the test scenario only. The purpose of the larger study was to investigate the effectiveness of the didactical approach of rule change in training adaptability, based on the two conditions. For the present study, the focus was not on the differences between conditions. The data of the entire participant sample was used for the questionnaires. The sample could be used entirely because the questionnaires were insensitive for the conditional differences, as they measured cognitive flexibility and adaptability in a

general context not directly related to the training. When analyses were based on training performance, only the data of the experimental condition was used.

Measures. The measures used in the present study are listed below. The independent measures for both hypothesis – (1) goal orientation predicting cognitive flexibility and adaptability, and (2) goal orientation predicting the benefits of adaptability training – were the two types of goal orientation: performance orientation and mastery orientation, which the participants possessed to a certain extent. Measures were divided into independent measures, dependent measures, and moderators. The dependent measures belonging to the first hypothesis were that of cognitive flexibility and adaptability. For the second hypothesis, the dependent measures consisted of the in-game performance and cognitive task performance. The study also included moderating measures, which were self-efficacy and metacognition.

Goal orientation. To assess goal orientation, a questionnaire constructed by Button, Mathieu, and Zajac (1996) was administered. This consisted of two independent sets of eight items: a set of items on performance goal orientation and a set on mastery goal orientation. The performance goal orientation items were indicating the level of desire to obtain favorable judgments of the participants' competence (e.g., *"The things I enjoy the most are the things I do the best."*), whereas mastery goal orientation items indicated the level of desire to perform challenging work, obtain new skills, and develop alternative strategies when performing a difficult task (e.g., "*I prefer to work on tasks that force me to learn new things."*) (Button et al., 1996). Participants were instructed to rate these items on a five-point Likert scale, ranging from strongly disagree to strongly agree.

Self-efficacy. The self-efficacy of participants was assessed using the New General Self-Efficacy (NGSE) Scale of Chen, Gully, and Eden (2001). This scale consisted of eight items and was self-rated by the participants using a five-point Likert scale, ranging from strongly disagree to strongly agree. An example of one of the items used is:

"I will be able to successfully overcome many challenges." (Chen, Gully, & Eden, 2001)

Metacognition. Metacognition was assessed using the Metacognitive Awareness Inventory (MAI) constructed by Schraw and Dennison (1994). This 52-item inventory addressed the metacognitive components of knowledge about cognition and regulation of knowledge using a five-point Likert scale, ranging from strongly disagree to strongly agree. Knowledge about cognition was assessed with the concepts of declarative knowledge (eight items), procedural knowledge (four items), and conditional knowledge (five items). An

example of an item that belonged to knowledge of cognition is *"I understand my intellectual strength and weaknesses."* This item belonged to the concept of declarative knowledge. Regulation of knowledge was assessed by the concepts of planning (seven items), information management strategies (ten items), comprehension monitoring (seven items), debugging strategies (five items), and evaluation (six items). An item used to assess regulation of knowledge was *"I ask myself periodically if I am meeting my goals."*, which belonged to the concept of comprehension monitoring (Schraw & Dennison, 1994).

Adaptability. To assess the general adaptive competence of participants, the Dutch Adaptability Dimensions and Performance Test (D-ADAPT) was developed and validated by TNO (Oprins, Van den Bosch, & Venrooij, in press). This questionnaire – translated into English by three subject matter experts – consisted of 31 items that were rated on a five-point Likert scale, ranging from very ineffective to very effective. The items were based on the six adaptability dimensions stated in the taxonomy of Pulakos et al. (2002): crisis adaptability (five items), creative problem solving (five items), cultural adaptability (five items), physical adaptability (six items), stress adaptability (five items), and interpersonal adaptability (five items). The items were presented to the participants in a random order. An example of one of the items used is: *"Comparing different solutions to a complex problem."* This item belonged to the dimension of creative problem solving.

Cognitive flexibility. The self-rated cognitive flexibility of the participants was assessed using the cognitive flexibility questionnaire of Martin & Rubin (1995). It consisted of 12 items on a five-point Likert scale, ranging from strongly disagree to strongly agree. This questionnaire was constructed to cover three components of cognitive flexibility: awareness that there are alternatives in a given situation, willingness to adapt to the situation, and self-efficacy in being flexible. An example of one of the items is: *"I can find workable solutions to seemingly unsolvable problems."* (Martin & Rubin, 1995).

In-game performance. Multiple measures assessed the in-game performance. To assess the effect of the adaptability training – by addressing the constituent of cognitive flexibility, sum scores of the test cases belonging to the consolidation phase and test phase of the test scenario were measured. The sum score of the test cases belonging to the learning phase was not used as this score was not representative for the ultimately gained knowledge on the initial rules. Because the purpose of the consolidation phase was to confirm whether participants had grasped the rules, the sum score of these test cases was used to measure the participants' knowledge on the initial rules. The sum scores on the test cases belonging to the test phase

was used as a measure of knowledge on the changed rules. Both sum scores ranged from zero to six, as a maximum score of two could be reached for each test case.

To assess whether participants had grasped the rule change, only the score on the second reflection of the test scenario – after the test phase – was used. This reflection consisted of six reflective questions. The score was determined by calculating the average score on the reflective questions. The choice to use the average was made in consideration of the larger study, as this study analyzed multiple moments of reflection with different numbers of questions. The reflective questions were rated by two experts using a scoring rubric consisting of keywords of the question's correct answer developed and reviewed by three experts. The development was an iterative process in which keywords were derived from expert answers and synonyms, together with the answers given by the participants. This rubric – including the reflective questions – can be found in appendix A. The inter-rater reliability between the two raters was calculated by using Cohen's Kappa. As this study is part of a larger study, Kappa was calculated for six items across the entire participant sample – including both conditions. The inter-rater reliability between the raters was found to be very high (Kappa=.94). After calculating the inter-rater reliability, the raters had reached consensus on scoring by discussing the answers that were differently rated.

Furthermore, the scores on the prioritization assignments of the test scenario at the end of the test phase were also used as a measure of understanding the changed rules. Three prioritization assignments – one on every rule – were conducted in which participants could score between eight and sixteen points. This score was based on the ordering of the actions prioritized. Four points were granted when the answer was placed correctly. Every place the action deviated from the correct answer, one point was deducted. In appendix C, a score sheet of the prioritization assignment can be found, which applied this way of scoring.

Cognitive task performance. Three computerized tasks were used to assess the cognitive flexibility in another context than that of the game: the Iowa Gambling Task (IGT), Wisconsin Card Sorting Task (WCST), and a modified version of the Balloon Task. With the IGT (Bechara, Damasio, Damasio, & Anderson, 1994), participants were presented with four decks of cards next to each other. The goal was to maximize their profit over 100 trails. Two of the decks were advantageous, meaning that a small profit could be made. The two other decks were disadvantageous. They had higher immediate wins, but choosing these decks also meant suffering from higher long-term losses resulting in a net loss. The participants had to discover the optimal strategy to maximize their profit. Task performance was measured by

subtracting the number of disadvantageous cards chosen from the number of advantageous cards chosen (Buelow, Blaine, Buelow, & Blaine, 2015). Scores could range from -100 to 100. A highly positive performance score would refer to a high cognitive flexibility.

The WCST (Grant & Berg, 1948) required the participants to infer changing categorization rules based on the color, shape, and number of the stimuli. When conducting the task, participants had to sort the cards according to the current categorization rule, which they had to discover themselves based on the given feedback stating either 'correct' or 'wrong'. After every ten correct sorts, a rule change would take place. During the task, six of those changes would occur. For participants who failed to detect rule change, a maximum number of 128 trails was set. Performance was measured by the number of trials, the number of errors, and the number of perseverative errors. (Feldman & Freitas, 2016). The lower the number of trials and both types of errors, the more cognitively flexible the participant had performed.

The last task used to assess cognitive flexibility was a modified Balloon Task (Ronay & von Hippel, 2015). In this task, participants were presented with an image of two balloons – a blue and a red one – accompanied by a balloon pump operated by a mouse. They had to pump up a series of those virtual balloons. For every pump, participants earned four cents in a temporary bank, but lost the earned money if the balloon popped before deciding to collect the money and move on to the next balloon. Feedback was given on the rule when the balloon popped to facilitate this decision making. During the first block, the red balloon popped at a smaller size than the blue one. This rule remained until participants had demonstrated they had learned to discriminate between the two balloons. At that point, the computer program reversed the inflatability of the balloons – the blue popping at a smaller size than the red one. Criterion for discriminant learning was set to be a difference of five or more pumps in the blue compared to the red balloon on three consecutive pairings or at the 24th balloon when the rule was not grasped. The task ended once the participants reached the same criterion for reversal learning or when they reached a maximum of inflating 48 balloons. Task performance was measured by using the residual score of reversal learning. Successful learning of this reversal of the rule was indicated by fewer pumps in the blue balloon and more in the red balloon after the rule change. The reversal learning score was calculated by dividing the number of pumps of the blue balloons before rule change by the number of pumps after rule change, plus the number of pumps of the red balloon after rule change

divided by pumps of red balloon pumps prior to the rule change. A higher score would therefore indicate a high cognitive flexibility (Ronay & von Hippel, 2015).

The IGT was measured using a pre- and posttest, whereas the WCST and the modified Balloon Tasks were only used as a posttest measure. The reason not to include a pre-test for the WCST and the modified Balloon task was to avoid priming effect, as both tasks involve an explicit rule change.

Procedure

Figure 3 visualizes the procedure of the study. The study was divided into two parts with an incubation period of five to fourteen days. This period allowed participants to process information, search their knowledge to identify relevant connections, and reflect on what they had learned. Another reason was that continuing to the next part without time in between could lead to a decreased performance due to fatigue (Sio & Ormerod, 2009). The study took place in a lab environment to preclude possible distractions. Conducting the first part of the study took approximately 2 hours. The second part took 3.5 hours.

In the first part, participants filled in an informed consent form before starting. Afterwards, they started with the IGT. This was done by referring to the instruction presented on the screen, which they were asked to read carefully. Upon finishing the IGT, participants called the experimenter to enable continuation with the questionnaires – measuring goal orientation, self-efficacy, and metacognition. After filling in these questionnaires, a verbal explanation was given on the first scenario in which they were notified that it was allowed to take notes and use a printed glossary. After this explanation, participants played the learning phase of the scenario. Upon finishing the learning phase, they reached the first learning guidance, as explained in the material section. After this guidance, the participants continued the game-play until they reached the next learning guidance. When completing this learning guidance, they had finished part 1.

Part 2 started with a recapitulation of part 1 and instructions for part 2. After being reminded how to play the game, participants started with the second training scenario including the learning guidance. When having finished, participants could choose to take a five-minute-break before starting the test scenario. When returned from their break, it was explained how to play the paper-based test scenario. With this explanation, it was also mentioned that this scenario was a test and that they had to try their best. After finishing the scenario, learning guidance consisting of three prioritization assignments (without expert answers) was

provided. Afterwards, participants were asked to complete the three cognitive tasks – IGT, WCST, and the modified Balloon task – of which the instructions were again presented on the screen. These tasks were followed by the questionnaires on goal orientation, adaptability, and cognitive flexibility. Participants were given their incentives after finishing the questionnaires.

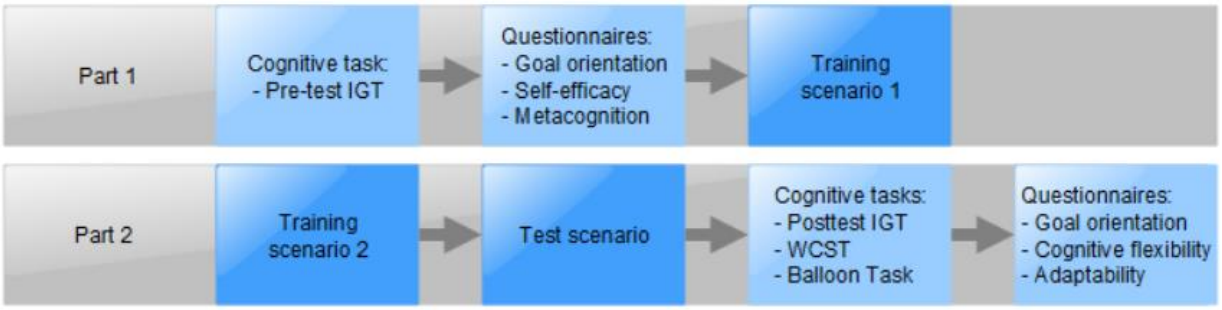

Figure 3. The procedure of the study.

Apparatus

A laptop was used to run the in JavaScript written game. The game itself was played using Firefox as a web browser. The experimental software to run the cognitive tasks of Iowa Gambling Task (IGT) and Wisconsin Card Sorting Task (WCST) was Inquisit 4.0 of Millisecond. The cognitive tasks used were obtained from the Millisecond library. The other task – the balloon task – was a web-based task using Firefox as a web browser.

Statistical analyses

Multiple statistical analyses were conducted in this study. To answer the first hypothesis, intercorrelations between goal orientation, cognitive flexibility, and adaptability were calculated. A high level of internal consistency was found for the adaptability dimensions (α = .78). Therefore, it was chosen to treat adaptability as one measure using the average score when calculating the intercorrelations between these constructs. Subsequently, a multivariate regression analysis was conducted if significant correlations were found. Cognitive flexibility and adaptability would function as the dependent variables, and the type of goal orientation correlating with these constructs as the independent variable. The dimensions were also analyzed separately by calculating intercorrelations. Again, when multiple significant correlations were found, a multivariate analysis was conducted. The adaptability dimensions would function as the dependent variable and the correlating type of goal orientation as the independent variable.

The second hypothesis regarding goal orientation and training performance was addressed by calculating Pearson's correlations between the types of goal orientation and the in-game performance measures of the test scenario: test phase scores, reflection questions,

and prioritizations. If correlations were found between a type of goal orientation and in-game performance measures, a multivariate regression was conducted with the in-game performance measures as dependent variables and the type of goal orientation as independent variable. Another aspect addressing this hypothesis was the calculation of intercorrelations between goal orientation and cognitive task performance. To further investigate whether goal orientation predicts cognitive task performance, a one-way ANCOVA was conducted with the task performance measure in question as dependent variable, the condition as independent variable, and the type of goal orientation which has shown to be correlated to that cognitive task measure as a covariate.

Besides the analyses conducted to answer the hypotheses, analyses were conducted with the intention to replicate findings of previous studies (e.g., Button et al., 1996; Chi, 2011; Ford et al., 1998; Griffin & Hesketh, 2003; Kozlowski et al., 2001; Stevens & Gist, 1997). Intercorrelations were calculated between goal orientation, self-efficacy, metacognition, cognitive flexibility, and adaptability. This was done using Pearson's correlations. Metacognition was assessed by the components of knowledge of cognition and regulation of knowledge, but since these have a high level of internal consistency ($\alpha = .90$), they were treated as one measure using the average score. Furthermore, a paired samples t-test was conducted to investigate a possible preference of goal orientation among participants.

Results

Goal orientation, cognitive flexibility, and adaptability. To analyze whether cognitive flexibility and adaptability can be predicted by goal orientation, intercorrelations between goal orientation, cognitive flexibility, and adaptability were calculated first. These results are presented in table 1. It shows that for performance orientation, no significant correlation was found with cognitive flexibility ($r = .15$, $p = .17$) nor adaptability ($r = .12$, $p = .28$), whereas for mastery orientation a significant correlation was found regarding these constructs (cognitive flexibility: $r = .24$, $p = .03$; adaptability: $r = .53$, $p < .01$). By conducting a multivariate regression with cognitive flexibility and adaptability as dependent variables and mastery orientation as the independent variable, it was investigated whether mastery orientation had predictive value regarding cognitive flexibility and adaptability. It was found that a mastery orientation could predict – self-rated – cognitive flexibility and adaptability ($F(2, 78) = 17.82$, $p < .01$). The variance by which mastery orientation could predict cognitive flexibility was 6 percent ($R^2 = .06$). For adaptability, this variance was 27 percent ($R^2 = .27$). A summary of statistics and results from this regression analysis can be found in table 2.

Table 1
Intercorrelations, means, and standard deviations of the variables of goal orientation; performance orientation and mastery orientation, cognitive flexibility adaptability, self-efficacy, and metacognition.

Variable	1	2	3	4	5	6
1. Performance orientation	–	.03	.15	.12	.10	.40**
2. Mastery orientation		–	.24*	.53**	.52**	.58**
3. Cognitive flexibility			–	.10	.17	.25*
4. Adaptability				–	.58**	.44**
5. Self-efficacy					–	.47**
6. Metacognition						–
M	3.83	3.93	3.69	3.76	3.66	3.57
SD	.42	.46	.35	.31	.52	.38

* $p \leq .05$
** $p \leq .01$

Table 2
Summary of statistics and results from the multivariate regression analysis for the predictor of mastery orientation on the dependent variables of cognitive flexibility and adaptability.

Dependent variable	Predictor	b	t	p	95% CI	
Cognitive flexibility	Mastery orientation	.19	2.24	.03	.02	.35
adaptability		.36	5.49	<.01	.23	.49

As shown in table 3, the separate dimensions of adaptability did not highly intercorrelate. Therefore, adaptability could also be treated as a multidimensional construct to answer the first hypothesis on whether goal orientation can predict adaptability. When focusing on these adaptability dimensions, a significant correlation was found between performance orientation and physical adaptability ($r = .29$, $p < .01$), whereas mastery orientation correlated with all the adaptability dimensions ($p < .01$) except for physical adaptability. By conducting a multivariate regression with the average scores on the adaptability dimensions as dependent variables and mastery oriented as the independent variable, it was found that a mastery orientation could predict – self-rated – adaptability ($F (6, 74) = 5.46$, $p < .01$). The variance by which mastery orientation could predict the adaptability dimensions can be found in table 3. As can be seen in table 4, mastery orientation predicts all the adaptability dimensions except for physical adaptability ($t (80) = 1.69$, $p = .10$).

Table 3
Intercorrelations, means, and standard deviations of the variables of goal orientation and adaptability dimensions.

Variable	1	2	3	4	5	6	7	8
1. Performance orientation	–	.03	.02	.06	<.01	.29**	.021	.038
2. Mastery orientation		–	.30**	.32**	.33**	.19	.39**	.35**
3. Crisis adaptability			–	.48**	.17	.23*	.28*	.13
4. Creative problem solving				–	.17	.17	.26*	.17
5. Cultural adaptability					–	.07	.27*	.24*
6. Physical adaptability						–	.52**	.01
7. Stress adaptability							–	.17
8. Interpersonal adaptability								–
M	3.83	3.93	3.76	3.62	3.77	4.06	3.53	3.84
SD	.42	.46	.48	.45	.62	.56	.61	.47
R^2	–	–	.10	.09	.11	.12	.15	.04

* $p \leq .05$
** $p \leq .01$

Table 4
Summary of statistics and results from the multivariate regression analysis for the predictor of mastery orientation on the dependent variables of the adaptability dimensions.

Dependent variable	Predictor	b	t	p	95% CI	
Crisis adaptability	Mastery orientation	.31	2.76	<.01	.09	.53
Creative problem solving		.31	2.99	<.01	.10	.52
Cultural adaptability		.44	3.12	<.01	.16	.72
Physical adaptability		.22	1.69	.10	-.04	.49
Stress adaptability		.52	3.78	<.01	.24	.79
Interpersonal adaptability		.35	3.30	<.01	.14	.56

Goal orientation and game performance. To answer the hypothesis whether goal orientation can predict the benefits of adaptability training, three different measures assessing the test scenario were used; test phase scores, reflective questions, and prioritizations. Only a significant correlation was found between performance orientation and the reflection of the test scenario (r = .39, p = .01). The correlations can be seen in table 5. Furthermore, a negative correlation was found between performance and mastery orientation (r = -.33, p = .03).

Table 5
Correlation, means, and standard deviations of the variables of goal orientation and game performance scores.

	Test scenario: Test phase	Test scenario: Reflection (after rule change)	Test scenario: Prioritization 1	Test scenario: Prioritization 2	Test scenario: Prioritization 3
Performance orientation	.19	.39*	.04	.11	.02
Mastery orientation	.05	.04	-.02	.18	.19
M	4.29	2.99	14.15	14.20	15.00
SD	1.10	1.76	1.90	2.60	1.87

* $p \leq .05$
** $p \leq .01$

Goal orientation and cognitive task performance. Another measure to answer the second hypothesis regarding goal orientation predicting adaptability training was that of participants' performance on the cognitive flexibility tasks, as cognitive flexibility was addressed being a constituent of adaptability. Table 6 shows the intercorrelations between goal orientation and tasks assessing cognitive flexibility. Only correlations were found between mastery orientation, and the WCST its total number of trials (r = -.32, p = .04) and errors (r = -0.35, p = .03).

Table 6
Correlation, means, and standard deviations of the variables of goal orientation and tasks assessing cognitive flexibility.

Variable	1	2	3	4	5	6	7	8
1. Performance orientation	−	-.33*	.08	.13	-.06	.16	.06	-.09
2. Mastery orientation		−	-.32*	-.35*	-.22	-.05	-.02	-.05
3. WCST: Total trials			−	.83*	.28	-.21	-.29	.17
4. WCST: Total errors				−	.11	-.03	-.16	.19

5. WCST: Perseverative errors					−	-.07	-.03	.06
6. IGT: Performance score (pre-test)						−	.64**	.10
7. IGT: Performance score (post-test)							−	-.05
8. Balloon Task reversal learning residual								−
M	3.81	3.93	94.76	24.42	6.61	4.20	27.17	.12
SD	.39	.41	21.01	20.72	3.12	37.07	44.78	.90

* $p \leq .05$
** $p \leq .01$

Because of the negative correlation found between mastery orientation and the number of errors made on the WCST, it was further investigated whether the errors were made as a result of the dispositional character of cognitive flexibility or as an effect of the training. This was assessed by conducting a one-way ANCOVA with the number of errors as dependent variable, the condition as independent variable, and mastery orientation as covariate. No significant difference was found ($F (1, 78) = .63$, $p = .43$) between the experimental ($M = 24.41$, $SD = 20.72$) and the control condition ($M = 28.07$, $SD = 21.44$).

Additional analyses. Besides the analyses conducted to answer the two hypotheses, analyses were conducted with the goal to replicate data of previous studies (e.g., Button et al., 1996; Chi, 2011; Ford et al., 1998; Griffin & Hesketh, 2003; Kozlowski et al., 2001; Stevens & Gist, 1997). Therefore, table 1 does also include the variables of self-efficacy and metacognition. Correlations between these two constructs, cognitive flexibility, adaptability, and the two types of goal orientation were calculated. Unexpectedly, no correlation was found between cognitive flexibility and self-efficacy ($r = .17$, $p = .13$), whereas between cognitive flexibility and metacognition the expected significantly positive correlation was found ($r = .30$, $p < .01$). Other significant correlations were found between adaptability and the constructs of self-efficacy and metacognition (respectively $r = .58$, $p < .01$; and $r = .44$, $p < .01$). The expectation of finding a correlation between adaptability and cognitive flexibility could not be met ($r = .09$, $p = .38$).

Regarding goal orientation, positive correlations were found between both mastery orientation and self-efficacy ($r = .52$, $p < .01$), and mastery orientation and metacognition ($r = .58$, $p < .01$), whereas for performance orientation, only a significant correlation was found for metacognition ($r = .40$, $p < .01$). Furthermore, the dimensionality of the types of goal orientation was addressed by calculating the correlation between them. As expected, no correlation was found between performance orientation and mastery orientation – when taking the entire participant sample, indicating goal orientation to be two-dimensional. By conducting a paired samples t-test with the two types of goal orientation as paired variables, it was investigated whether participants had a preference of orientation. No clear preference was found between the two types of goal orientation ($t(80) = -1.51$, $p = .13$), as can be seen in figure 4 visualizing the distribution of how participants scored themselves being performance-oriented and mastery-oriented individuals on a five-point Likert scale.

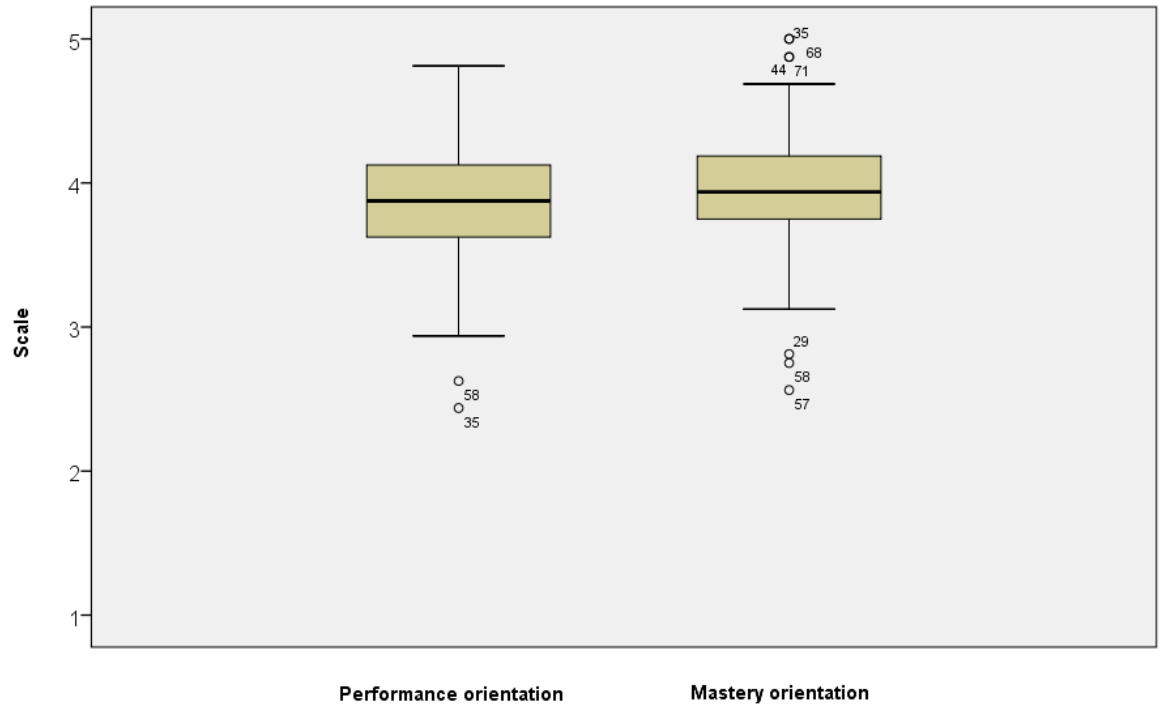

Figure 4. The distribution of self-rated performance orientation and mastery orientation on a five-point Likert scale.

Discussion

The goal of the present study was to explore to what extent goal orientation can predict one's cognitive flexibility and adaptability, and if goal orientation can predict one's training performance. If this can be confirmed, it would become possible to map adaptability in work environments by using the construct of goal orientation, and training of adaptability could be improved by taking in to account one's goal orientation.

The first hypothesis to explore the predictive value of goal orientation stated that goal orientation predicts cognitive flexibility and adaptability. This hypothesis was deducted to mastery-oriented individuals being more adaptive, as it was inclined that mastery-oriented participants are more capable of gaining knowledge and skills from experience and evaluating situational changes (Gist & Stevens, 1998; Kozlowski et al., 2001). No such relation was expected for performance-oriented individuals because they are assumed to see no need in putting in more effort into changing strategies when performing poorly, as they see their performance as a reflection of their ability (Gist & Stevens, 1998; Stevens & Gist, 1997). The inclination of the hypothesis regarding mastery orientation was confirmed as not only positive correlations were found between mastery orientation and both cognitive flexibility and adaptability, but also by the predictive value found for mastery orientation on these two constructs. When focusing on the different dimensions of adaptability, all dimensions except for physical adaptability correlated positively with mastery orientation and could even be predicted by this type of goal orientation, whereas for performance orientation only physical adaptability correlated. A possible explanation could be the that questions of the D-ADAPT regarding physical adaptability were asked in a way that is more in line with performance orientation. The questions addressing physical adaptability asked participants to take into account their own physical ability in uncertain, demanding circumstances. An example of a question addressing this dimension of adaptability was: *"knowing your boundaries in physically demanding situations"*. This reflection on physical ability could have caused the positive correlation found between performance orientation and physical adaptability, as performance-oriented individuals view outcomes as a reflection of an ability (Gist & Stevens, 1998). Mastery-oriented individuals do not view outcomes as such. They tend to focus on improving outcomes by altering strategies, instead of focusing on the restrictions of their physical boundaries (Gist & Stevens, 1998). Therefore, the insignificance of the positive correlation between mastery-orientation and physical adaptability could be caused by the questions focusing on physical adaptability as ability, which is more typical for performance orientation. Except for physical adaptability, no further relations were found between performance orientation and cognitive flexibility, nor adaptability. The results of this study can therefore be said to back-up the theoretical implications made and the first hypothesis was confirmed entirely.

The second hypothesis addressed by the present study stated that goal orientation predicts the benefits of adaptability training – by addressing the constituent of cognitive

flexibility. This hypothesis can be broken down by the inclination that (1) mastery-oriented individuals are assumed to be more receptive to the learning opportunities of training, whereas (2) performance-oriented individuals are less receptive due to their superficial ways of learning (Gist & Stevens, 1998; Kozlowski et al., 2001). Therefore, it was expected to only find positive correlations between mastery orientation and the game performance measures. However, this hypothesis could not be confirmed. Only a positive correlation was found between performance orientation and the reflection questions of the test scenario assessing the rule change. This was unexpected as this goal orientation is linked to a lower receptiveness to learning opportunities. However, this positive relation could possibly be ascribed to the distinction that can be made in performance orientation (Hsieh, Sullivan, & Guerra, 2007). Individuals can have a performance-approach orientation, wherein individuals want to demonstrate their competence; or a performance-avoidance orientation, where individuals are mainly occupied by hiding their lack of ability. A possible distribution of performance-orientated participants being more often performance-approach oriented than performance-avoidance oriented could explain the positive relation found, as performance-approach oriented individuals tend to show their competence when feeling capable performing the task (Hsieh et al., 2007). Due to the absence of further correlations, there was no use to further analyze the data for the predictive value of mastery orientation on the in-game performance. A possible explanation for these insignificant results found could be that playing three scenarios was too little practice to see a difference in game performance regarding goal orientation. Performance-oriented individuals might have had a slight advantage compared to mastery-oriented individuals due to their tendency of maximizing performance on short term, focusing on surface characteristics. In contrast, mastery-oriented individuals use trial-and-error to test the effectiveness of multiple strategies, which would eventually provide them with a better in-depth, understanding of the situation. However, it would also take longer to reach this understanding (Kozlowski et al., 2001). Therefore, it could be possible that the mastery-oriented participants did not have enough time to practice, manifesting in (lower) in-game performance scores still based on trial-and-error.

Other measures to assess the second hypothesis of goal orientation predicting the benefits of adaptability training were that of the cognitive flexibility tasks, as the adaptability training addressed cognitive flexibility as a constituent of adaptability. Again, based on the characteristics of the two types of goal orientation explained by previous studies (e.g., Gist & Stevens, 1998; Kozlowski et al., 2001), positive correlations were expected between mastery

orientation and task performance, whereas for performance orientation no such correlations were expected. Regarding performance orientation, the expectation was met as no correlations were found. In contrast, for mastery orientation the expectations were not met as correlations were only found for the WCST's total number of trials and errors. A possible reason for finding only these correlations could be that the WCST is based on multiple rule changes that you can only determine by trying out different possibilities – which is a characteristic of mastery orientation, whereas the other two tasks (IGT and the modified Balloon Task) only contain one rule change, making these tasks less prone to differences in goal orientation. As the total number of errors made in the WCST is used determining one's cognitive flexibility (Feldman & Freitas, 2016), finding a positive correlation was promising. Although, what must be considered is that cognitive flexibility is a dispositional trait as well. Therefore, this result could not directly be attributed to an effect of the training – improving cognitive flexibility within its boundaries. To investigate if the training did influence the number of errors made on the WCST, differences between conditions were analyzed with mastery orientation as covariate. However, no significant difference was found. This implies that the positive correlation between mastery orientation and the number of errors could not be attributed to the training itself. Therefore, together with the findings on the in-game performance, the second hypothesis was rejected entirely.

What must be noted regarding the correlations used to test the second hypothesis is that a significant negative correlation was found between the two goal orientations, which contradicts with the two-dimensional character of the trait. This could be attributed to the fact that the sample was not big enough, as no such correlation was found when looking at the entire sample instead of only the experimental condition. Another aspect regarding the second hypothesis that has to be taken into account is that the purpose of the larger study – of which this study was a part – was to develop adaptability training. Despite that the findings of the larger study regarding conditional differences in in-game scores and reflective questions supported the notion that training with rule changes enhances coping with such changes, no significant differences were found between conditions for the cognitive flexibility tasks. As these are validated tasks known for measuring cognitive flexibility, the construct validity of the game has to be evaluated critically. Although as mentioned earlier, these tasks are known for measuring cognitive flexibility as a dispositional trait, and not necessarily the ability to improve one's cognitive flexibility within its boundaries. Therefore, it could be argued

whether these measures of cognitive flexibility are appropriate for the purpose of the (larger) study.

As findings of previous studies were used as a basis for the theoretical background of this study, analyses of those studies were replicated in order to check for the established findings. Intercorrelations were investigated between adaptability, cognitive flexibility, self-efficacy, and metacognition; and between goal orientation, self-efficacy, and metacognition. As expected, a positive correlation was found between cognitive flexibility and metacognition. Also, adaptability correlated positively with the constructs of self-efficacy and metacognition. These results align with those of previous studies addressing cognitive flexibility and adaptability (e.g., Chi, 2011; Ford et al., 1998; Griffin & Hesketh, 2003; Kozlowski et al., 2001). However, no correlations were found between cognitive flexibility and adaptability, and cognitive flexibility and self-efficacy. These results were unexpected as cognitive flexibility is known to be the cognitive aspect of adaptability (Good, 2014) and previous study had shown a correlation between the constructs of cognitive flexibility and self-efficacy (e.g., Stevens & Gist, 1997). An explanation for this insignificance of correlations could be the lack of the questionnaires' specificity. The lacking correlation between cognitive flexibility and adaptability could possibly be described by the D-ADAPT being a general measure addressing the six dimensions of adaptability developed by Pulakos et al. (2000). These dimensions do not cover the specific trait of cognitive flexibility, explaining the insignificant result found. The insignificant result regarding cognitive flexibility and self-efficacy could be explained by the fact that other factors could have affected the perceived self-efficacy of the participants (e.g. activities or life events), as self-efficacy is a task-specific trait (Bandura, 1977). Because self-efficacy is task specific, it should be assessed at an optimal level of specificity corresponding to the task or domain (Pajares, 1996). In this study, self-efficacy was assessed by a general self-efficacy scale without any specification, this could have affected the results.

Regarding the relations of goal orientation, self-efficacy, and metacognition, many of the results aligned with the results found in previous studies (e.g., Button et al., 1996; Ford et al., 1998). As expected, results confirmed that goal orientation is a two-dimensional construct, as performance and mastery orientation did not correlate. Furthermore, similar results were found for mastery orientation as in the study of Ford et al. (1998). Both mastery orientation and self-efficacy, and mastery orientation and metacognition, correlated positively with each other. Unexpectedly, no correlation was found between performance orientation and self-

efficacy and a positively significant correlation was found between performance orientation and metacognition. In previous studies (e.g., Ford et al., 1998; Stevens & Gist, 1997), negative relations were found for both constructs. The unexpected results of the present study regarding performance orientation and self-efficacy could be explained by the use of a questionnaire on general self-efficacy, as task specificity was required (Pajares, 1996). Ford et al. (1998) used a task specific self-efficacy questionnaire, which could explain why they did find the expected negative correlation between performance orientation and self-efficacy. A second explanation for the discrepancy in results between performance orientation and self-efficacy could be that the expression of performance orientation differed for participants. Inconsistent findings have been found before in terms of how performance orientation is related to self-efficacy due to the further distinction that can be made between a performance-approach orientation and a performance avoidance-orientation (Hsieh et al., 2007). The performance-avoidance orientation is found to be negatively related to self-efficacy, like the performance orientation used by Ford et al. (1998). Although, for the other type or performance orientation – performance-approach orientation, inconsistencies have been found (Hsieh et al., 2007). Some researchers found this approaching type of performance orientation to be positively related to self-efficacy, whereas others found no relation at all (Hsieh et al., 2007). Therefore, it is likely that the relation not being found in this study could be attributed to the two described types of performance orientation intervening with each other. A possible explanation for the unexpected result of this study regarding metacognition could be that the study of Ford et al. (1998) was based on a questionnaire assessing metacognitive activity within the task, whereas the present study focused on a general scale of metacognition (the metacognitive awareness inventory). The questionnaire of Ford et al. (1998) consisted of only 12 items addressing self-monitoring of learning and self-evaluation of progress. It could be possible that within the activity addressed, participants acted primarily performance oriented maximizing their performance focusing on a narrow set of surface characteristics, indicating a relatively poor metacognition for that activity (Kozlowski et al., 2001). This explanation is in line with the description of Button et al. (1996) describing goal orientation as a dispositional trait that will predispose individuals to adopt particular response patterns across situations, but that individuals may adopt a different response pattern depending on situational characteristics. However, the different components of metacognition that address the reflective aspect of metacognition and the control aspect of learning: knowledge of cognition and knowledge recognition, were not assessed by those 12 items. The positive correlation of the more general metacognitive questionnaire used that includes these aspects – the MAI –

was still unexpected, but due to the generality of the questionnaire it is possible that the results were affected by participants being both performance and mastery orientated, as no significant difference was found between these orientations. This finding of participants having no preference in goal orientation was supported by the study of Button et al. (1996), stating that participants can be both performance and mastery oriented, and thus possess traits belonging to both orientations (e.g., a high level of metacognition).

All the correlations found in this study regarding both the hypotheses and additional analyses were incorporated in the conceptual structure of constructs with the expected correlations. Some of the expected correlations – as can be found in figure 1 – were revised according to the correlations found in this study. This visualization of correlations found can be seen in figure 5.

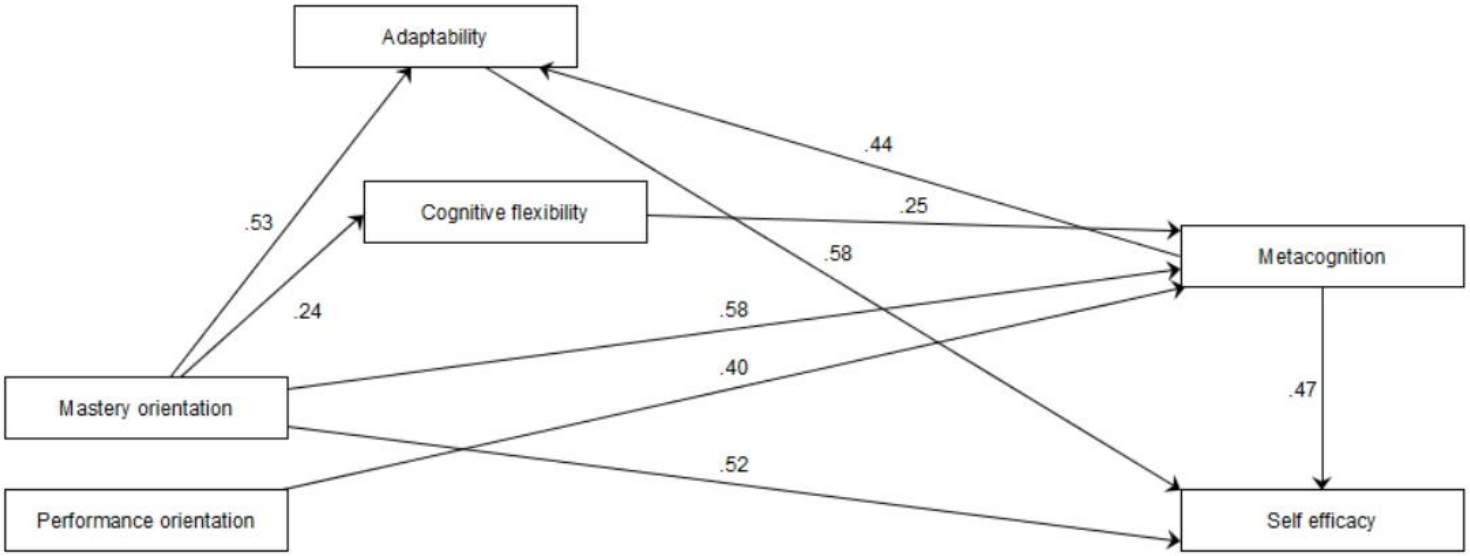

Figure 5. Conceptual structure of constructs: the correlations found.

In conclusion, the present study was an exploratory study regarding the influence of goal orientation on adaptability training. The results were promising to the extent that the first hypothesis was confirmed, as mastery orientation was found to be a predictor of self-rated cognitive flexibility and adaptability, and that this orientation could be used as a predictor for all the adaptability dimensions except for physical adaptability. However, no correlation could be found between goal orientation and the effect of adaptability training. Together, these findings show the potential of focusing on goal orientation when an intervention is developed to address adaptability in work environments. Although, caution is necessary as the second hypothesis addressing adaptability training was rejected. It could be useful to investigate

different approaches of developing an intervention training adaptability, as there is evidence that goal orientation affects one's adaptability.

The overall explanation for the rejection of the second hypothesis regarding adaptability training was the timeframe of the training. Having only two training sessions – consisting of three scenarios – it is possible that mastery-oriented individuals did not yet reach the point of benefiting from using trial-and-error to find an appropriate strategy, lacking the in-depth understanding the second hypothesis was based on. Therefore, a recommendation for future research would be to extend the period of the training by including more training scenarios. Furthermore, in this study several unexpected findings were found with the possible explanation of questionnaires being too general. In future research, this limitation could be overcome by using more specific questionnaires. Developing a self-efficacy questionnaire more geared to the domain of adaptability training is therefore recommended. The best time to assess this more specific self-efficacy would then be at the end of the training. Regarding goal orientation it would be best to use a questionnaire which makes the distinction between the different types of performance orientation, as these orientations could be related differently to cognitive flexibility, adaptability, and its training. Also, an interview could be conducted to administer the approach participants used to reach a goal to get a better insight in one's goal orientation used during training, as it appeared that participants can possess both orientations. If these recommendations appear effective and differences can be found between training performance for different goal orientations, training methods on adaptability could be adapted according to those differences and a suitable training could be developed to be adaptable towards the changing work situations of today.

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Appendix A: Reflective questions and its scoring rubric

1. What actions do you need to take when the trained dog is being hesitant and keep circling around, instead of sitting down, after searching a person or a vehicle and why? Write your answer in a maximum of two short sentences.

-**SME answer example**: This means normally there was no contact with a drug; however, more detailed search such as x-ray scan or full body search or full vehicle inspection is needed since new drug cannot be detected by dogs.

-**Grading key words**: check vehicle, check by DEA agent, look for secret compartments, manual search, check for new drugs, further inspection, x-ray, interrogation is needed (+0.5) / different (specific, illegal) drug, new drug, new kind of drug (powder, substance, chemical), new formula, still suspect, smell like alcohol (+0.5)

-**Score**: Total 1: +0.5 each (action/reasoning) if any of those keywords are included in the answer. +1 if both answers are present.

2. What actions do you need to take when the substance from a quick surface drug test turns to orange, instead of blue and why? Write your answer in a maximum of two short sentences.

-**SME answer example**: This means normally there was no contact with a drug; however, more detailed search such as x-ray scan or full body search or full vehicle inspection is needed since new drug cannot be detected by surface test.

-**Grading key words**: check vehicle, check by DEA agent, x-ray, manual search, check for new drugs, further inspection, interrogation is needed (+0.5)/new drug, different drug, new formula, still suspect, smell like alcohol (+0.5)

-**Score**: Total 1: +0.5 each (action/reasoning) if any of those keywords are included in the answer. +1 if both answers are present. If they immediately mention arrest it is wrong since the test was negative

3. What actions do you need to take on a driver who wants to import prohibited fruits for commercial use? Write your answer in a maximum of two short sentences.

-**SME answer example**: For commercial use, the rule is same (confiscated, fined) for the first time. After the first time breaking this regulation, the entry to the U.S will be blocked for 6 months.

-**Grading key words**: block entry (for 6 months), deny entry, deny access to US, check whether this (violating regulation) has happened before, check whether the driver has done this before, not welcome for 6 months, cannot enter the US, not grant access, grant access in no record (let through)

-**Score**: +1 if any of those keywords are included in the answer. When mentioning 10 years (rule 3) instead of 6 months it is considered as correct.

4. What actions do you need to take on a driver who wants to import prohibited fruits for personal use? Write your answer in a maximum of two short sentences.

-**SME answer example**: Due to the law change, prohibited agricultural goods for non-commercial use will be confiscated and fined.

-**Grading key words**: fine (fee)

-**Score**: +1 if any of those keywords are included in the answer. -0,5 when mentioning denying access since that is a different rule.

5. What actions do you need to take when a driver approaches your booth with an outdated state registration? Write your answer in a maximum of two short sentences.

-**SME answer example**: The driver should be fined and the vehicle will be confiscated until 2 days after the update of state registration.

-**Grading key words**: confiscate (take) the vehicle, wait for … days, deny access for … days, temporarily (1-100) days taken away

-**Score**: +1 if any of those keywords are included in the answer.

6. What actions do you need to take when a driver approaches your booth with a mismatch of the vehicle's brand and with an outdated state registration? Write your answer in a maximum of two short sentences.

-**SME answer example**: The driver should be fined, arrested after interrogation for vehicle theft and the entrance to the U.S. will be denied for 10 years.

-**Grading key words**: deny entrance, block entrance, cannot enter the US, not grant access, not allowed to enter, deny entrance for… years, prohibit travel to the country (US)

-**Score**: +1 if any of those keywords are included in the answer.

Appendix B: Prioritizations

Prioritization S1.1

The most important goal of operation Tobor is to free the citizens of Vina. You and your units are still in the combat near the town hall (under cover), where citizens of Vina are held hostage. All red, blue, and green robots are visible around the town hall and you are going to command your units to defeat those robots and take the town hall.

Below are a series of possible actions you may take. Some options describe a set of highly suitable actions; other options show less suitable actions, or even not suitable at all.

Given from what you have learned during this scenario, order the options in terms of their suitability. For every option, write down a reason why you put the particular option in 1st place, 2nd place etc. on the suitability ranking (max 3 sentences for every option).

Most suitable option	2nd best option	3rd best option	Least suitable option

a) - Command your combat unit to attack the blue robots to minimize the casualty on your unit.
- Command your unit to use EMP grenades when attacking the blue robots.
- Order (via communication channel) your units that are stationed outside the wall to pass the turrets and bring supplies for citizens via tanks.

b) - Command your combat unit to attack the red robots to minimize the casualty on your unit.
- Order your unit to use EMP grenades when attacking the red robots.
- Command (via communication channel) your units that are stationed outside the wall to pass the turrets and bring supplies for citizens via trucks.

c) - Command your combat unit to attack the green robots to prevent them communicating to their headquarter for a backup.
- Command your unit to use water cannons when attacking the green robots.
- Order (via communication channel) the units that are stationed outside the wall to pass the turrets and bring supplies for citizens via helicopters.

d) - Command your combat unit to continue attacking the red robots that are guarding the town hall.
- Command your unit to use EMP grenades when attacking the red robots.
- Command (via communication channel) the units that are stationed outside the wall to pass the turrets and bring supplies for citizens on foot (via passage where the radar of turrets cannot reach).

SME answer S1.1

Underneath you see the answers of the subject matter expert. It consists of an ordering and reasoning, just like you've made yourself. You have to compare the order and reasoning of the expert with your own order and reasoning. Write this comparison in the table you were given.

Most suitable option	2nd best option	3rd best option	Least suitable option
D	**b**	**c**	**a**

d) This is indeed the option with the best actions to take.

- To reach the citizens, red robots should be eliminated first due to their combat power.
- Using EMP grenades is the suitable method to attack the red robots.
-Also, the units outside the wall can successfully pass the turrets on foot (via passage where the radar of turrets cannot reach). and bring supplies for the citizens.

b) This is the second best option.

- To reach the citizens, red robots should be eliminated first due to their combat power.
- Using EMP grenades is the suitable method to attack the red robots.
- However, the trucks will not be able to pass the gate and reach citizens since they will be destroyed by the turrets.

c) This is the third best option.

- Preventing enemy communication, by attacking the green robots is a good action.
- However, they cannot be defeated by using fire arms.
- Moreover, helicopters will not able to fly over the wall, they will be destroyed by the turrets.

a) This is the worst option due to several reasons.

- Blue robots impose no direct danger as they are not armed, they don't do combat, but maintenance.
- Even when blue robots are to be attacked, they are vulnerable to water, not to EMP grenades.
- Finally, tanks will be attacked by turrets when passing the gate, so this is not a good action either.

Comparison S1.1

Compare your answers to that of the experts. Write down the differences between your answers and that of the expert in the "differences" box for all four actions.

	Differences
A	
B	
C	
D	

Prioritization S1.2

Although you've won the battle of Vina, not all robots in Vina were destroyed. They have retreated and you have not received any intel about enemy robots since then. This morning, you received a report about the location of the robots. Your scouts discovered an old abandoned factory where new robots are being built. This factory is about 20 km south of Vina. Your scouts discovered that the factory is secured by armed robots and there are turrets installed at every entrance of the factory. With this information being provided by the scouts, you have deployed your units near the factory, outside the turret radar. It is your mission to destroy the robots and to destroy the factory facility where the new robots are being built. You are preparing an attack.

Below are a series of possible actions you may take. Some options describe a set of highly suitable actions; other options show less suitable actions, or even not suitable at all.

Given from what you have learned during this scenario, order the options in terms of their suitability. For every option, write down a reason why you put the particular option in 1st place, 2nd place etc. on the suitability ranking (max 3 sentences for every option).

Most suitable option	2nd best option	3rd best option	Least suitable option

a) - Command to send the drones with cameras inside the factory and order you units to pass the turrets on foot (via passage where the radar of turrets cannot reach).
- Attack the blue robots when entering the factory, so they cannot fire back.
- Order your units to use EMP grenades when attacking the blue robots.

b) - Command to send tanks to pass the turrets and to breach into the factory.
- Attack the green robots when entering the factory, so they cannot fire back.
- Order your units to use water cannons when attacking the green robots.

c) - Command to order you units to pass the turrets on foot (via passage where the radar of turrets cannot reach).
- Attack the red robots when entering the factory, so they cannot fire back.
- Order your units to use water cannons when attacking the red robots.

d) - Command to send the drones with cameras inside the factory and order you units to pass the turrets on foot (via passage where the radar of turrets cannot reach).
- Attack the blue robots when entering the factory, so they cannot fire back.
- Order your units to use water cannons when attacking the blue robots.

SME answer S1.2

Underneath you see the answers of the subject matter expert. It consists of an ordering and reasoning, just like you've made yourself. You have to compare the order and reasoning of the expert with your own order and reasoning. Write this comparison in the table you were given.

Most suitable option	2nd best option	3rd best option	Least suitable option
d	a	c	b

d) This is indeed the option with the best actions to take.

- turrets can be passed safely by flying objects as well as on foot (via passage where the radar of turrets cannot reach).
- Blue robots are armed and should therefore be attacked first as they can attack your units.
- Water is and effective weapon against blue robots.

a) This is the second best option.

- Your choice to use drones and foot soldiers (via passage where the radar of turrets cannot reach) to safely pass the turrets is appropriate.
- To attack the blue robots first is also appropriate, as these are armed.
- However, blue robots are only vulnerable to water, not to EMP grenades.

c) This is the third best option.

- Your choice to use drones and foot soldiers (via passage where the radar of turrets cannot reach) to safely pass the turrets is appropriate.
- However, blue robots should be attacked first, not the red robots.
- And, when attacking red robots, EMP grenades should be used.

b) This is the least preferred option due to several reasons.

- Turrets can be safely passed on foot (via passage where the radar of turrets cannot reach). or through the air, but not by vehicles.
- Green robots are for doing maintenance, not for combat.
- And, when attacking green robots, hacking is appropriate, not water. Green robots are immune to water.

Comparison S1.2

Compare your answers to that of the experts. Write down the differences between your answers and that of the expert in the "differences" box for all four actions.

	Differences
A	
B	
C	
D	

Prioritization S2.1

During the international nano medicine symposium, a presentation of an Egyptian PhD student caught your interest. He developed a nanomedicine to fight a virus that has similar characteristics as the virus you investigated in Xeni. You arranged a visit to his university so he can show you his work and explain his research in detail. Your goal is to introduce this student into your research community by sharing your scientific values and methods, and to optimize research by smart collaboration. Today you are visiting the lab with this student.

Below are a series of possible actions you may take. Some options describe a set of highly suitable actions; other options show less suitable actions, or even not suitable at all.

Given from what you have learned during this scenario, order the options in terms of their suitability. For every option, write down a reason why you put the particular option in 1st place, 2nd place etc. on the suitability ranking (max 3 sentences for every option).

Most suitable option	2nd best option	3rd best option	Least suitable option

a) - Tell the student to change a damaged glove before touching a sample.
- Ask the student to test the effects of the silver-based nano medicine before testing other materials.
- Share your data with the student and discuss possible outcomes and side effects from all tested types of medicine.

b) - Tell the student to change a damaged glove before touching a sample.
- Ask the student to test the effects of the magnetic-based nano medicine before testing other materials.
- Tell the student not to report any insignificant data when he writes a paper.

c) - Tell the student that the pressure for results warrants relaxed lab safety procedures.
- Ask the student to test the effects of the gold-based nano medicine.
- Tell the student to keep his research findings private to safeguard future opportunities.

d) - Tell the student to change a damaged glove before touching a sample.
- Ask the student to test the effects of the silver-based nano medicine before testing other materials.
- Discuss the future prospects of silver-based nano medicine only and tell him to not to report insignificant results in his future papers.

SME answer S2.1

Underneath you see the answers of the subject matter expert. It consists of an ordering and reasoning, just like you've made yourself. You have to compare the order and reasoning of the expert with your own order and reasoning. Write this comparison in the table you were given.

Most suitable option	2nd best option	3rd best option	Least suitable option
a	**d**	**b**	**c**

a) **This is indeed the option with the best actions to take.**

- Changing gloves will prevent possible danger as well as contamination into the sample.
- Based on the strong effect from the Xeni experiment, testing silver-based nanomedicine first is the most logical step. Although your time is limited, it is important to test all four materials and to examine how this virus reacts to each type of medicine.
- Discussing both possible outcomes and side effects of all four materials can put his research forward and also yours.

d) **This is the second best option.**

- Telling the student to change gloves is appropriate.
- Testing silver-based medicine first is also a good decision based on the results in Xeni.
- However, you should discuss the prospects and drawbacks of all medicines, not only about the positive outcomes of silver.

b) **This is the third best option.**

- Telling the student to change gloves is a good action.
- However, it was the silver-based sample that proved to be the most effective in the Xeni experiment, not the magnetic sample.
- Also, the prospects of all data should be reported when writing a scientific paper.

c) **This is the worst option, due to several reasons.**

- First, safety requires that all lab safety procedures should be strictly followed. So you should have warned the student to change his gloves.
- Second, it was the silver-based sample that proved to be the most effective in the Xeni experiment, not the gold sample. Besides, other samples should be tested as well.
- Lastly, you should discuss the prospects of all medicines and promote him to share the research findings (i.e., present at a conference) for advancing the research.

Comparison S2.1

Compare your answers to that of the experts. Write down the differences between your answers and that of the expert in the "differences" box for all four actions.

	Differences
A	
B	
C	
D	

Prioritization S2.2

The war in Nibua came to an end and you returned to the Netherlands. Meanwhile, the war between two countries, Yeni and Kamam, continues to cause many casualties. You receive a call from the UN army stationed in Yeni requesting your expertise on nanotechnology. You flew to their base on the next day. A UN official gives a briefing to a group of scientists, including you. The UN-official states that Kamam has been carrying out attacks using a genetically engineered virus. The virus brings about the same symptoms to the virus in Nibua. You are appointed as project leader to lead these experts. The UN wants you to setup a confidential project in which you and your team examine the virus that has been used in the attacks and to develop a nano vaccine that provides protection against the virus as soon as possible. They already have set up a nano lab for you. A quick safety check has already been performed before your arrival. Due to the war, resources are limited and the condition of the lab is poor. You notice, for example, that there are no sterilization facilities. Your team is currently in the lab, examining a sample of the virus.

Below are a series of possible actions you may take. Some options describe a set of highly suitable actions; other options show less suitable actions, or even not suitable at all.

Given from what you have learned during this scenario, order the options in terms of their suitability. For every option, write down a reason why you put the particular option in 1st place, 2nd place etc. on the suitability ranking (max 3 sentences for every option).

Most suitable option	2nd best option	3rd best option	Least suitable option

a) - Inform the UN official that sterilization facilities are lacking and refuse to conduct lab-experiments until these have been installed.
- Once the facility is ready, order your team to test the silver-based vaccine.
- Call your expert colleagues in the Netherlands using your laptop and discuss your intermediate findings.

b) - Because sterilization facilities are lacking, order your team to clean the gears by using extra chemicals, and to take showers before entering and upon leaving the lab.
- Order your team to first test the virus with silver-based vaccine then to run tests on the other materials.
- Call your expert colleagues in the Netherlands via your phone and discuss your intermediate findings.

c) - Because sterilization facilities are lacking, order your team to wear extra protective gears when entering the lab and to clean the gears thoroughly after each use.
- Suggest your team to test the virus with magnetic-based vaccine first, then to test the other materials for the medicine.
- To consult additional expertise, email the intermediate results your expert colleagues in the Netherlands to ask them for suggestions and criticism

d) - Because sterilization facilities are lacking, order your team to use alcohol for sterilization before entering and upon leaving the lab.
- Order your team to first conduct tests on the magnetic-based vaccine, then to run tests on the other materials.
- Discuss intermediate results and to set out a plan for the remaining work to be done in a secured room.

SME answer S2.2

Underneath you see the answers of the subject matter expert. It consists of an ordering and reasoning, just like you've made yourself. You have to compare the order and reasoning of the expert with your own order and reasoning. Write this comparison in the table you were given.

Most suitable option	2nd best option	3rd best option	Least suitable option
d	**c**	**b**	**a**

d) This is indeed the option with the best actions to take.

- The time pressure upon developing a medicine quickly necessitates smart solutions to the poor conditions you have to work in. Using alcohol for sterilization is then an appropriate decision.
- The experiment in Nibua revealed that silver-based vaccine causes severe bleedings; the magnetic-based vaccine was most effective. Therefore, it is logical to test magnetic-based sample first.
- Indeed, discussion is productive but you need to take precautions to make sure that scientific knowledge does not fall into wrong hands.

c) This is the second best option.

- Wearing extra protective gears is a good alternative when sterilization facilities are lacking.
- Indeed, the magnetic-based vaccine was most effective in Nibua, so it is logical to try this material first.
- Although you might receive good feedback from your other colleagues in the Netherlands, emailing the results is dangerous as your email can be hacked relatively easily by the enemy.

b) This is the third best option.

- Using extra chemicals for cleaning and taking more showers are good alternatives when sterilization facilities are lacking.
- However, the earlier experiences in Nibua showed that the silver-based vaccine causes severe side effects; the magnetic-based vaccine proved to work best in Nibua. Thus, the magnetic-based vaccine should be tested first.
- Discussion is productive but using a call to do so is very dangerous as the enemy can wiretap your call relatively easily.

a) This is the worst option due to several reasons.

- First, the poor conditions are inevitable during wartime, and by refusing to search for alternative solutions, you make it impossible to find a cure for a dangerously spreading disease.
- Also, the earlier experiences in Nibua showed that the silver-based vaccine causes severe side effects, making tests on silver vaccine inappropriate. Therefore, magnetic-based vaccine should be tested first, and then other vaccines should be tested as well to develop an effective vaccine.
- Lastly, discussion is productive but using your laptop to do so is very dangerous as the call can be wiretapped relatively easily by the enemy.

Comparison S2.2

Compare your answers to that of the experts. Write down the differences between your answers and that of the expert in the "differences" box for all four actions.

	Differences
A	
B	
C	
D	

Prioritization TS 1

After the morning rush hour, you had a short break with a colleague. After the break, your colleague asked for your assistance on contraband control at a non-commercial, fast lane. Your goal is to search for any hidden contraband on passengers and their vehicles. A Mexican family pulls over their luxurious car. They seem nervous and you smell alcohol in the car. Below are a series of possible actions you may take. Some options describe highly suitable actions; other options show less suitable actions, or even not suitable at all.

Below are a series of possible actions you may take. Some options describe a set of highly suitable actions; other options show less suitable actions, or even not suitable at all.

Given from what you have learned during this scenario, order the options in terms of their suitability. For every option, write down a reason why you put the particular option in 1st place, 2nd place etc. on the suitability ranking (max 3 sentences for every option).

Most suitable option	2nd best option	3rd best option	Least suitable option

a) - Conduct a manual search in the vehicle.
- Use the trained dog to search for contraband in the vehicle.
- Let the family pass if the dog acts hesitant and circles around.

b) - Send the car to an x-ray machine for a vehicle inspection.
- Do a manual search on all members of the family and the vehicle.
- Let the family pass if no contraband is found.

c) - Check the alcohol level on all family members.
- Do a quick surface drug test on all family members.
- Let the family pass if the substance from the drug test turns to blue.

d) - Conduct a manual search on the vehicle and on all members of the family.
- Do a quick surface drug test on both parts of vehicle and on all members of the family.
- Let the family pass if the substance from the drug test turns to orange.

Prioritization TS 2

You are assigned at the fast lane and it's 18:00, rush hour with a shortage on staff. So you have to interchangeably check both a commercial and non-commercial lane. Your goal is to check for prohibited agricultural goods to prevent those goods entering the U.S. You pull over an American family in a camping car at the non-commercial lane, and a Mexican farmer on his pick-up truck on commercial lane. Both the family and the farmer are carrying biological oranges from the fly infested region. You noticed the farmer already received a fine a week ago for importing prohibited agricultural goods.

Below are a series of possible actions you may take. Some options describe a set of highly suitable actions; other options show less suitable actions, or even not suitable at all.

Given from what you have learned during this scenario, order the options in terms of their suitability. For every option, write down a reason why you put the particular option in 1st place, 2nd place etc. on the suitability ranking (max 3 sentences for every option).

Most suitable option	2nd best option	3rd best option	Least suitable option

a) - Confiscate the oranges from the family and don't issue a fine.
- Confiscate the oranges from the farmer and issue a fine.
- Grant entrance to the U.S. to both family and the farmer.

b) - Confiscate the oranges from the family and don't issue a fine.
- Confiscate the oranges from the farmer and don't issue a fine.
- Grant entrance to the U.S. to both family and the farmer.

c) - Confiscate the oranges from the family and issue a fine.
- Confiscate the oranges from the farmer and issue a fine.
- Grant entrance to the U.S. to the family only and deny entrance to the farmer for six months.

d) - Confiscate the oranges from the family and issue a fine.
- Confiscate the oranges from the farmer and issue a fine.
- Grant entrance to the U.S. to both family and the farmer.

Prioritization TS 3

You are still working at the fast lane and it's 18:40, still during the rush hour. This time, you have to interchangeably check two non-commercial, fast lanes. You are not using the guide mode currently. Your goal is to check for vehicle license registration so that all vehicles entering the U.S. have the most updated, ordered registration. You are checking a Mexican man riding a Yamaha motorbike registered in Nevada state and an American woman driving an Audi car registered in Kansas state. You noticed there is mismatching information in the system. For the motorbike, the registration shows up as BMW brand registered in Texas. For the car, the registration shows up as Audi registered in Oklahoma state.

Below are a series of possible actions you may take. Some options describe a set of highly suitable actions; other options show less suitable actions, or even not suitable at all.

Given from what you have learned during this scenario, order the options in terms of their suitability. For every option, write down a reason why you put the particular option in 1st place, 2nd place etc. on the suitability ranking (max 3 sentences for every option).

Most suitable option	2nd best option	3rd best option	Least suitable option

a) - Issue a fine to the woman and confiscate her vehicle until two days after she renews her state registration.
- Issue a fine to the man, confiscate the motorbike and arrest him for motorbike theft.
- Grant the woman to enter to the U.S. and deny the man from entering the U.S for 10 years.

b) - Warn the woman to renew her state registration without a fine.
- Warn the man to renew his state registration without a fine.
- Grant the entrance to the U.S. to both woman and to man.

c) - Issue a fine to the woman and warn her to renew her state registration.
- Issue a fine to the man and confiscate the motorbike without arresting him.
- Grant the entrance to the U.S. to both woman and to man.

d) - Issue a fine to the woman and warn her to renew her state registration.
- Issue a fine to the man, confiscate the motorbike and arrest him for a motorbike theft.
- Grant the woman to enter to the U.S. and deny the man from entering the U.S for 10 years.

Appendix C: Prioritization scoring sheet

Prioritization TS 1 answer: B, D, A, C

	Possible answer	Scoring (min 8-max 16)
1	BDAC	16
2	BADC	14
3	BDCA	14
4	DBAC	14
5	ABDC	12
6	ADBC	12
7	BACD	12
8	BCAD	12
9	BCDA	12
10	DABC	12
11	DBCA	12
12	ABCD	10
13	ADCB	10
14	CBAD	10
15	CBDA	10
16	CDAB	10
17	CDBA	10
18	DACB	10
19	DCAB	10
20	DCBA	10
21	ACBD	8
22	ACDB	8
23	CABD	8
24	CADB	8

Prioritization TS 2 answer: C, D, A, B

	Possible answer	Scoring (min 8-max 16)
1	CDAB	16
2	CADB	14
3	CDBA	14
4	DCAB	14
5	ACDB	12
6	ADCB	12
7	CABD	12
8	CBAD	12
9	CBDA	12
10	DACB	12
11	DCBA	12
12	ACBD	10
13	ADBC	10
14	BCAD	10
15	BCDA	10
16	BDAC	10
17	BDCA	10
18	DABC	10
19	DBAC	10
20	DBCA	10
21	ABCD	8
22	ABDC	8
23	BACD	8
24	BADC	8

Prioritization TS 3 answer: A, D, C, B

	Possible answer	Scoring (min 8-max 16)
1	ADCB	16
2	ACDB	14
3	ADBC	14
4	DACB	14
5	ABCD	12
6	ABDC	12
7	ACBD	12
8	CADB	12
9	CDAB	12
10	DABC	12
11	DCAB	12
12	BACD	10
13	BADC	10
14	BDAC	10
15	BDCA	10
16	CABD	10
17	CDBA	10
18	DBAC	10
19	DBCA	10
20	DCBA	10
21	BCAD	8
22	BCDA	8
23	CBAD	8
24	CBDA	8