

Can motto-goals outperform learning and performance goals? Influence of goal setting on performance and affect in a complex problem solving task

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In this paper, we bring together research on complex problem solving with that on motivational psychology about goal setting. Complex problems require motivational effort because of their inherent difficulties. Goal Setting Theory has shown with simple tasks that high, specific performance goals lead to better performance outcome than do-your-best goals. However, in complex tasks, learning goals have proven more effective than performance goals. Based on the Zurich Resource Model (Storch & Krause, 2014), so-called motto-goals (e.g., *"I breathe happiness"*) should activate a person's resources through positive affect. It was found that motto-goals are effective with unpleasant duties. Therefore, we tested the hypothesis that motto-goals outperform learning and performance goals in the case of complex problems. A total of $N = 123$ subjects participated in the experiment. In dependence of their goal condition, subjects developed a personal motto, learning, or performance goal. This goal was adapted for the computer-simulated complex scenario Tailorshop, where subjects worked as managers in a small fictional company. Other than expected, there was no main effect of goal condition for the management performance. As hypothesized, motto goals led to higher positive and lower negative affect than the other two goal types. Even though positive affect decreased and negative affect increased in all three groups during Tailorshop completion, participants with motto goals reported the lowest rates of negative affect over time. Exploratory analyses investigated the role of affect in complex problem solving via mediational analyses and the influence of goal type on perceived goal attainment.

Keywords: problem solving, goal setting, affect, performance, Tailorshop

Global problems like climate change, unstable political systems, and the financial crisis pose complex challenges. Hence, solving complex problems is seen as key competency in today's world (Funke, 2013a; Greiff, Holt, & Funke, 2013). An important research question in motivational psychology is how goals must be designed to successfully guide behavior (Locke & Latham, 1990). Connecting these two lines

of research, the present study investigates in what way different goal types influence complex problem solving.

Complex Problem Solving (CPS)

As defined by Dörner, Kreuzig, Reither, and Stäudel (1983), complex problems are characterized by five criteria: First, as the name suggests, the problem is *complex* such that the number of involved variables is high. Second, these variables are *mutually connected*. Third, the system is *dynamic* and changes over time – be it due to its own momentum or due to the problem solver's actions. Fourth, the relationships between the different variables are *intransparent*, so that the problem solver does not have all the information necessary to reach an optimal decision. Fifth, the problem solver pursues *multiple goals* which frequently work in opposite directions. CPS performance is often assessed via computer-simulated microworlds, which simulate the structural dependencies and the temporal dynamics of a given problem (Funke, 2010). In the present study, the well-established Tailorshop microworld was applied. In this simulation, participants are asked to behave like the CEO of a small shirt factory who aims to maximize the company value (e.g., Danner, Hagemann, Holt, et al., 2011; Danner, Hagemann, Schankin, Hager, & Funke, 2011; Funke, 2010).

Past research hints at a relationship between the affect a person experiences and his or her CPS performance. Yet, two contradicting directions of influence are suggested by theory and research: On the one hand, positive affect might be helpful in CPS situations because it is associated with higher self-esteem (e.g., Brown & Mankowski, 1993), creativity (Estrada, Isen, & Young, 1994; Isen, Daubman, & Nowicki, 1987), and a stronger confidence in one's own resources (Schwarz & Skurnik, 2003). Negative affect, in turn, fosters analytic, and systematic processing – a competency that is vital in CPS (Barth & Funke, 2010; Spering, Wagener, & Funke, 2005). Thus, positive as

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well as negative affect seem to mobilize distinct resources for CPS.

Two experiments that analyzed the influence of affect in a CPS task are worth mentioning. Sperring et al. (2005) asked participants to manage a forest enterprise in a computer simulation. Before working on the task, participants received false positive or negative feedback on an intelligence test to trigger either positive or negative affect. The analyses showed that, surprisingly, affect did not influence CPS performance. Nevertheless, participants with negative feedback gathered more information at the beginning of the task. This is in accordance with the above mentioned phenomenon that negative affect fosters the acquisition of new information. Barth and Funke (2010) found further evidence for analytic processing in negative affective environments. Their participants worked on the Tailorshop which was either characterized by a positive environment (positive performance feedback through increasing profit) or by a negative environment (negative performance feedback through decreasing profit). As expected, the positive environment fostered positive affect whereas the negative environment fostered negative affect. The analyses revealed that the negative environment increased CPS performance – a result that had not been found in the above mentioned study by Sperring et al. (2005). Yet, a mediational analysis did not display the hypothesized influence of affect on the environment-performance relationship. In fact, the environment influenced affect, profit, and information retrieval, but affect did not have a mediating function. Hence, negative environments were beneficial for analytic processing and CPS performance, but the exact role of affect still remains to be clarified.

The results suggest that it might not be affect itself that influenced CPS performance but the degree of information retrieval or features of the environment. Hence, mobilizing useful resources might be more important in CPS than fostering a certain affective pattern. Still, it is important to regard CPS not only as a cognitive, but also as an emotional and motivational process (cf. Funke, 2003, 2010, 2014). After all, affect and performance probably influence each other constantly. In the present study, a mediational analysis was conducted to explore the interplay between affect and performance. Doing this, we investigated whether the relationship between affect before and after CPS can be explained by CPS performance. Hence, the analysis covered both the influence of affect on CPS and the influence of CPS on affect.

Classic goal setting research

One of the most famous and widespread motivational psychological theories is probably Goal Setting Theory by Locke and Latham (1990), which is based on two main assumptions: First, *goal difficulty* positively predicts performance, provided that a person's ability level is not exceeded. Second, *goal specificity* plays a crucial role: The authors propose that high and specific goals give rise to a better performance than so-

called do-your-best goals (i.e., the task to show the best possible performance). It is important to mention that when the authors speak of high, specific goals they mostly refer to *performance* goals, i.e., goals that focus on the performance outcome (Seijts, Latham, & Woodwark, 2013).

The great success of Goal Setting Theory in simple laboratory tasks notwithstanding, several studies have shown that in more complex tasks, high, specific goals led to a *lower* performance than do-your-best goals (e.g., Earley, Connolly, & Ekgren, 1989; Kanfer & Ackerman, 1989; Mone & Shalley, 1995). Resource allocation can explain this finding: Participants who do not have sufficient experience with a task benefit from putting cognitive resources into the discovery of task strategies rather than the achievement of a certain performance outcome (Kanfer & Ackerman, 1989). Faced with these results, a number of subsequent studies revealed that in complex tasks, high, specific *learning goals*, focusing on the discovery of required task strategies, can lead to a higher performance than do-your-best as well as performance goals (e.g., Seijts, Latham, Tasa, & Latham, 2004; Winters & Latham, 1996).

To our knowledge, the affective content of learning vs. performance goals directly after goal induction has not been investigated so far. Yet, research has shown that performance goals that students develop in university classes (i.e., striving after favorable judgments of one's competence) can increase their anxiety, hopelessness, and shame about an upcoming exam in this particular class – at least when the goal focuses on avoiding negative judgments. Learning goals, on the other hand, (i.e., striving after increasing one's competence) can increase enjoyment, hope, and pride and decrease boredom and anger (Daniels et al., 2009; Pekrun, Elliot, & Maier, 2006; Pekrun, Elliot, & Maier, 2009). Hence, it can be assumed that already the induction of learning goals might trigger a more positive affective pattern than the induction of performance goals. Investigating the influence of goal setting during task completion, research has revealed that performance goals can be associated with a feeling of helplessness, negative self-cognitions, and maladaptive attributions of failures when confronted with obstacles. In contrast, learning goals seem to be associated with higher positive affect and with more effective problem-solving strategies (Diener & Dweck, 1978, 1980; Dweck & Leggett, 1988). Moreover, learning goals seem to buffer against negative performance feedback (Cianci, Klein, & Seijts, 2010; Kozlowski & Bell, 2006). Consequently, learning goals should lead to a more positive affective pattern directly after their induction as well as during CPS than performance goals. However, most of the cited studies applied moderately complex tasks which did not always fulfill the complexity criteria established by Dörner et al. (1983). One objective of the present study was to investigate goal setting in a truly complex problem solving task.

A new approach: Motto-goals

While the previous paragraph made clear that learning goals seem more adaptive than performance goals in complex tasks, the following section delineates why so-called motto-goals might be even more successful. In their Zurich Resource Model (ZRM), Storch and Krause (2014) developed motto-goals as a new goal type. Other than high, specific goals, they describe an individual approach towards a task and aim to activate a person's (unconscious) resources for this very situation. To develop a motto-goal, participants are instructed to choose from a variety of pictures one picture that triggers positive affect and that may serve as resource regarding a specific situation¹. Next, the person is given several positive associations with the picture and is instructed to select his or her favorite ideas. Using these ideas, the person then develops a personal goal in a stepwise process. The resulting goal is called motto-goal and reflects how the particular person aims to approach the specific situation (e.g., *I climb the mountain step by step and in my own pace*). A central feature of motto goals consists of the affective response to the goal: During the whole process, emphasis is put on the development of a goal that triggers positive affect and that is associated with zero negative affect (Storch & Krause, 2014).

One of the ZRM's underlying models is Kuhl's PSI theory (2001). Motto-goals should activate the *extension memory*, a highly inferential and complex system that is assumed to process information intuitively, holistically, flexibly, and very fast². According to Kuhl (2000), the extension memory "integrates an extended network of representations of own states, including personal preferences, needs, emotional states, options for action in particular situations, and past experiences involving the self" (p. 131). This suggests that motto-goals foster flexible and creative behavior, which might be especially helpful in complex situations.

The ZRM has been applied successfully in a wide variety of settings – be it in coaching and adult education (Storch & Krause, 2014), to treat persons with clinical disorders (Schuler & Sandmeier, 2008), or in organizational settings (e.g., Temme, 2013). It has been shown that motto-goals, when compared to a control group, are able to reduce participants' cortisol level in a stress test (Storch, Gaab, Küttel, Stüssi, & Fend, 2007), to help patients with eating disorders to down-regulate negative affect and to reduce dietary restrains (Storch, Keller, Weber, Spindler, & Milos, 2011), and to increase affect regulation competencies in persons participating in a health prevention program (Storch & Olbrich, 2011). Apart from this overall positive effect of motto-goals, further studies specifically compared motto-goals to high, specific goals. For example, it has been shown that motto-goals increase positive and decrease negative affect more effectively than high, specific goals (e.g., Temme, 2013; Weber, 2013) and that they are associated with higher goal attainment, higher personal identification (Bruggmann, 2003), and

higher goal commitment (Huwlyer, 2012) than high, specific goals.

One study seems particularly useful to draw inferences about motto-goals in CPS settings and is therefore explained in more detail: Weber (2013) asked participants to name an unpleasant duty they had to deal with at the moment. More than half of the subjects chose duties from the categories *writing texts* (e.g., bachelor or master thesis), *preparing and reworking studies* (e.g., studying for exams), and *handing in work on time* (e.g., managing documents or bills). These categories can arguably be considered CPS situations. Weber's participants then took part in a goal training where they developed either a motto-goal (e.g., *Dynamically and full of joy I dash towards my goal*) or a high, specific goal (e.g., *During the next three weeks, I will write my master thesis from Monday to Friday from 9 till 12 am. Meanwhile, I switch off my mobile phone and my email inbox and I don't let anything distract me*) to approach their unpleasant duty³. Weber showed that the motto-goal training significantly increased participants' positive and decreased their negative affect while high, specific goals did neither influence positive nor negative affect. Furthermore, motto-goals led to higher subjective change of experience and behavior one week after the training and to a stronger increase of self-reported action orientation after failure than high, specific goals. When considering that many participants in Weber's study chose rather complex unpleasant duties, the comparatively successful handling of unpleasant duties through motto-goals might be transferred to the CPS setting in the present study.

The present study

The objective of the present study was twofold. First, we aimed to replicate the superiority of learning over performance goals in a truly complex task. Second, we investigated whether the advantage of motto-goals over high, specific goals can also be found in a CPS task. The first part of the study concerned the influence of goal setting on CPS performance. As described above, past research revealed that learning goals can lead to higher task performance than performance goals in complex environments. This leads to the first hypothesis:

Hypothesis 1a: Participants with high, specific learning goals show a higher CPS performance than participants with high, specific performance goals.

Motto goals, however, might be even more adaptive as they can activate the extension memory, which is

¹Another possibility is the construction of a general motto-goal without having a specific situation in mind for which the goal might be helpful (Storch & Krause, 2014).

²For a comprehensive overview of PSI theory, see Kuhl (2000) and Kuhl (2001).

³A third group dealt with a positive imagination of future goal realization. As this goal type is not considered in the present study, the study description is confined to motto-goals and high, specific goals.

considered helpful in complex environments. For instance, it can help to flexibly adjust goals in a CPS task and to search for new problem solving strategies (Biebrich & Kuhl, 2003). Further, motto-goals aim to make use of unconscious thought processes which seem important to achieve successful problem solving (e.g., Dijksterhuis, Bos, Nordgren, & van Baaren, 2006; Dijksterhuis & Nordgren, 2006). As explained above, research has already shown that persons pursuing motto goals can handle unpleasant duties more successfully than persons pursuing high, specific goals (Weber, 2013). The present study hypothesizes that this is also the case for complex problems:

Hypothesis 1b: Participants with motto-goals show a higher CPS performance than participants with high, specific performance or learning goals.

The second part of the study concerned the influence of goal setting on positive and negative affect before and after CPS. As described above, motto-goals are by definition associated with high positive and low negative affect, which is corroborated by research investigating affect after goal induction (Temme, 2013; Weber, 2013). Based on these results, we formulate the following hypothesis:

Hypothesis 2a: The induction of motto-goals leads to higher positive and lower negative affect than the induction of high, specific learning or performance goals.

Findings on learning and performance goals further suggest that learning goals might be associated with higher positive and lower negative affect than performance goals (Daniels et al., 2009; Pekrun, Elliot, & Maier, 2006; Pekrun, Elliot, & Maier, 2009), which leads to the following hypothesis:

Hypothesis 2b: The induction of high, specific learning goals leads to higher positive and lower negative affect than the induction of high, specific performance goals.

Next, affective change due to CPS was considered. Complex problems, as they are very difficult to complete successfully, are likely to trigger frustration and a feeling of being overwhelmed. However, this might vary in dependence of goal setting. In case it was true that motto goals activate the extension memory, they should allow an integration of (possibly frustrating) Tailorshop experiences into the self and avoid a feeling of helplessness and frustration (Biebrich & Kuhl, 2003; Kuhl, 2001):

Hypothesis 3a: After having worked on the CPS task, positive affect decreases less and negative affect increases less for participants with motto-goals than for participants with learning or performance goals.

Research indicates that learning goals seem to buffer against negative feedback more effectively and to be associated with higher positive affect than performance goals (Cianci, Klein, and Seijts, 2010; Diener & Dweck, 1978, 1980; Dweck & Leggett, 1988; Kozlowski & Bell, 2006). Hence, we postulated the following hypothesis:

Hypothesis 3b: After having worked on the CPS task, positive affect decreases less and negative affect increases less for participants with learning goals than for participants with performance goals.

Apart from these specific hypotheses, the study contained an exploratory part: First, the interplay between affect and CPS performance was investigated via mediational analyses. As explained above, positive as well as negative affect might be helpful in CPS tasks. Past research delivered inconsistent findings and suggested that it might not be affect itself that fosters CPS performance, but a high degree of information retrieval or certain features of the environment. Hence, although we assume that motto-goals are associated with high positive and low negative affect and foster high CPS performance, it seems inappropriate to derive specific hypotheses regarding the interplay between affect and performance. Second, we analyzed possible differences between the three goal types regarding perceived goal achievement, satisfaction with goal achievement, and difficulty of goal achievement.

Method

The hypotheses were tested in a randomized experimental study. Depending on the experimental condition, participants were instructed to develop (1) a high, specific performance goal, (2) a high, specific learning goal, or (3) a motto-goal adapted for the Tailorshop. With the respective goal in mind, they completed the Tailorshop scenario.

Participants and design

An a-priori power analysis was conducted to estimate the number of participants required to reveal significant group differences. This was achieved via G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). Following Tabachnick & Fidell (2007), a power of $1 - \beta = 0.80$ with $\alpha = 0.05$ was preset. Seijts et al. (2004) reported an effect size of $\eta^2 = 0.07$ regarding differences in CPS performance between participants with learning, performance, or do-your-best goals. Although we applied motto-goals instead of do-your-best goals in our study, the effect size might be a good estimate for the expected effect of the goal manipulation on Tailorshop performance. Hence, we used this value to calculate the required sample size. Results of the power analysis showed that a total sample size of 132 participants should suffice to detect significant group differences.

We managed to recruit a total of 123 subjects (99 female, 24 male) aged between 17 and 35 years ($M = 21.19$, $SD = 3.51$)⁴. The majority of them ($n = 105$) were psychology students of Heidelberg University. They received course credit for participation.

A mixed factorial design was applied. Goal type served as between-subjects factor with three levels (performance goals: $n = 40$; learning goals: $n = 41$; motto-goals: $n = 42$). Affect was measured three times (baseline; after goal induction; after problem solving), so that the time of measurement constituted a within-subjects factor. Data was collected in a computer laboratory in groups of 3 to 20 participants who worked on the task on their own and were asked not to interact with each other.

Experimental task

The CPS task was the latest German version of the Tailorshop scenario (Danner, Hagemann, Holt, et al., 2011). In this computer simulation, subjects are the managers of a fictional organization that produces and sells shirts. It consists of two phases with different requirements: In the exploration phase, participants are instructed to explore the system freely over a simulated period of 6 months. During the second phase, the control phase, participants manage the Tailorshop for 12 months with the assignment to maximize the company value. The Tailorshop version used in the present study consists of 24 variables, of which 22 are visible in the user interface, and 12 can be directly controlled by the participants (e.g., *salary*). 12 variables cannot be manipulated directly, but are influenced by the subjects' actions (e.g., *job satisfaction*). When participants click the "next" button, the passing of one month is simulated and the updated values of the system are displayed and visualized by arrows pointing up or down (Danner, Hagemann, Holt, et al., 2011). A demo version of the Tailorshop can be found online (<https://www.psychologie.uni-heidelberg.de/ae/allg/tools/tailorshop/>).

Procedure

The experiment lasted approximately one hour, but there was no imposed time limit. The study was entirely computer-based and programmed with the online survey tool Questback EFS 10.4 (<http://www.unipark.com/>). When subjects arrived in the computer lab, they signed an informed consent and were given brief information about the study's purpose and procedure. Thereafter, they completed the questionnaire, which was identical in all three conditions except for the goal induction part. Figure 1 illustrates the questionnaire's composition.

After a baseline measure of positive and negative affect (T1), subjects read the standard instruction of the Tailorshop and were presented a graph illustrating the performance of previous participants which was based on data by Danner, Hagemann, Holt, et al. (2011). This way, they familiarized themselves with

the task, but did not gain any positive or negative experience with it. Next, participants were instructed to develop a personal performance goal, a learning goal, or a motto-goal for the Tailorshop, depending on their experimental condition. Thereafter, affect was measured a second time (T2) and participants worked on the Tailorshop scenario. Before the exploration and the control phase started, they were reminded to keep their goal in mind. After Tailorshop completion, affect was measured a third time (T3). For exploratory purposes, questions regarding goal attainment and sociodemographic data were assessed in the end.

Manipulation of goal type

Goal induction in all conditions started with a short text, framed in a goal-type specific way. Participants in the *performance goal condition* were instructed to maximize their performance, to show their competence, and to avoid errors during Tailorshop completion. Subjects in the *learning goal condition* were instructed to maximize their learning success, to comprehend the relations underlying the system, and to regard errors as learning opportunity. Texts for the learning and performance goal conditions were based on instructions of previous studies (Cianci, Klein, & Sejts, 2010; Kozlowski & Bell, 2006; Sejts et al., 2004). Participants in the *motto-goal condition* were asked to mobilize their own resources, to develop a personal approach to the task, and to see the Tailorshop as opportunity to make use of their own resources.

In a next step, participants were instructed to develop a personal goal for the Tailorshop. In the performance and learning goal condition, a high, specific goal was predetermined based on the data of previous studies to ensure that subjects indeed pursued such a goal. The predefined performance goal was to maintain a company value of at least 250,000 units, which had been reached by the best 10% in the study by Danner, Hagemann, Holt, et al. (2011) and can therefore be considered a high, specific goal (Kanfer & Ackerman, 1989; Locke & Latham, 1990; Winters & Latham, 1996). Similarly, in the learning goal condition, the predetermined goal was to learn at least 15 relationships between the different Tailorshop variables. This had been achieved by the best 10% in a previous study applying concept maps (Öllinger, Hammon, von Grundher, & Funke, 2015). To align the time participants spent on goal setting across conditions and because motto-goal induction requires time due to the manualized process, subjects with learning and performance goals were instructed to answer specific questions step by step. After having developed a first version of the goal, they were asked to formulate it in first-person perspective. Next, they were instructed to add until when they wanted to achieve the goal. In a next step, they included the methods they planned to use to reach their goal. Last, they were asked why they strived for this goal. In every step, they were

⁴A post-hoc analysis applying G*Power revealed that the actual power given the 123 participants was $1 - \beta = 0.77$.

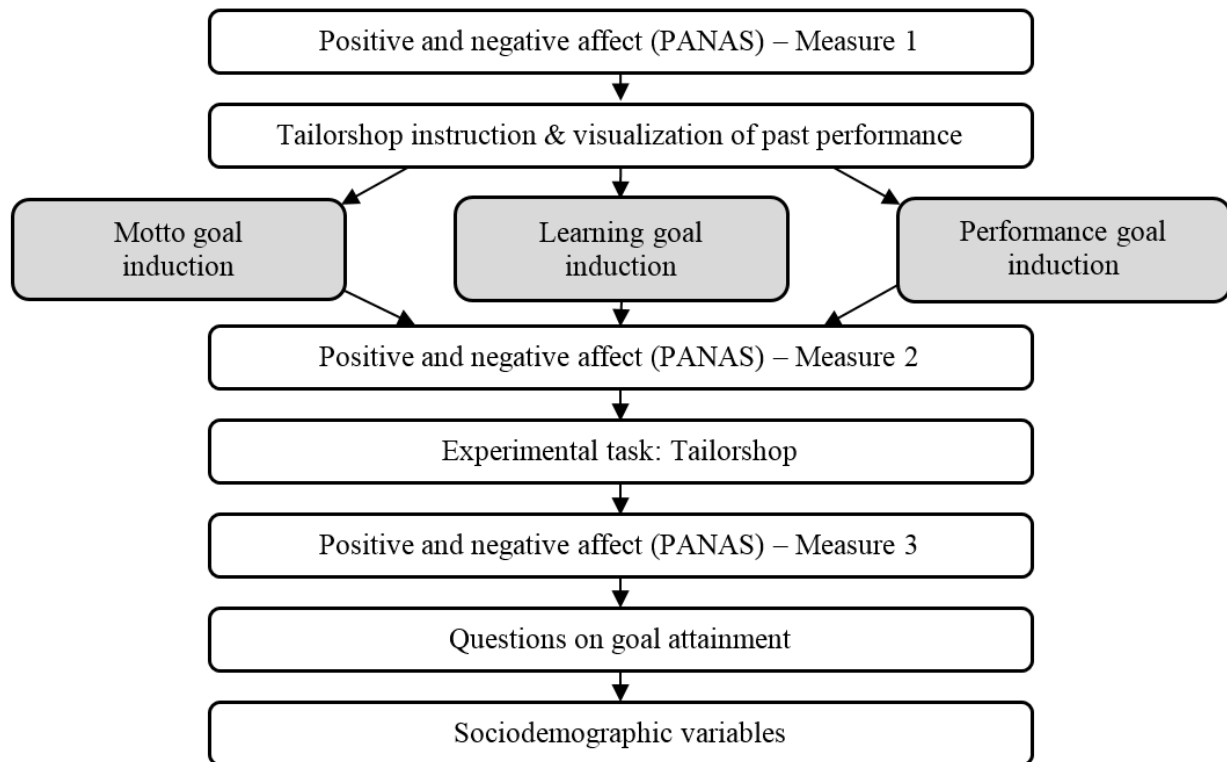


Figure 1. Course of the online questionnaire.

shown the latest version of their individual goal and added their new thoughts in a text field. Sample goals of the participants are *I want to understand at least 15 relationships within the 12 months through high attention and concentration in order to apply that knowledge to increase my company value* (learning goal) and *Within 12 months I will reach a company value of at least 250000 with the help of motivation, intelligence, and organisation, in order to be successful and because I have the responsibility* (performance goal).

In the motto-goal condition, participants were shown 10 pictures (e.g., *boy who just caught a fish*) in randomized order and were asked to choose one of them which was associated with a good feeling and which served as resource for the Tailorshop. After they had made their decision, subjects chose their favorite associations on this particular picture from a list depicting many different ideas (e.g., *"Yeah, I made it", "childlike joy", or "to present and enjoy success"*). Using these favorite associations, they were asked to formulate a personal motto-goal which described how they planned to approach the Tailorshop (e.g., *I want to be like a child – without fear and without too much rumination – and be happy about my success and shout: Yeah, I made it!*)⁵.

Measures

CPS performance. Following past research (Danner, Hagemann, Holt, et al., 2011; Danner, Hagemann, Schankin, et al., 2011; Meyer & Scholl, 2009; Öllinger et al., 2015), only performance in the control phase of the Tailorshop was analyzed. This was done via two

indicators: The *company value change* (CV change) describes the absolute difference between the company value at the beginning of the Tailorshop, which was the same for all participants, and the final company value. The *company value trend* (CV trend) indicates the number of months in which the company value increased. As proposed by Danner, Hagemann, Holt, et al. (2011), only trends between the second and the last month were included.

Positive and negative affect. Participants' momentary positive and negative affect was assessed on a 5-point Likert scale via the German version of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) from Krohne, Egloff, Kohlmann, and Tausch (1996), which consists of 20 adjectives on two largely independent subscales. 10 items measure positive (e.g., *interested, enthusiastic*) and 10 items negative affect (e.g., *upset, ashamed*). The internal consistency was high for both positive (measure 1: Cronbach's $\alpha = .84$, measure 2: $\alpha = .91$, measure 3: $\alpha = .91$) and negative affect (measure 1: Cronbach's $\alpha = .73$, measure 2: $\alpha = .81$, measure 3: $\alpha = .86$).

Questions on goal. For exploratory purposes, subjects rated on a 10-point Likert scale to what degree they had achieved their goal (*not achieved at all –*

⁵For a comprehensive description of the motto-goal development, see Storch and Krause (2014); for a motto-goal online tool similar to the one used in the present study, see <http://ismz.ch/ZRM/OnlineTool.html>.

completely achieved), how satisfied they were with this achievement (*not satisfied at all – completely satisfied*), and how difficult it was to achieve the goal (*not difficult at all – extremely difficult*).

Results

Before conducting the analyses, 5 participants (motto-goals: $n = 2$, learning goals: $n = 2$, performance goals: $n = 1$) were identified as outliers ($z > 3.29$, $p < .001$) regarding CV change or negative affect. Following Tabachnick and Fidell (2007), the deviant scores were not excluded, but adjusted to the next extreme score of the respective condition, so that their statistical impact did not distort the analyses, but the fact that the persons had extreme values was taken into account⁶.

Table 2. Planned contrasts to analyze the influence of goal type on performance.

Contrast	Motto-goals	Learning goals	Performance goals
1	2	-1	-1
2	0	1	-1

Influence of goal type on CPS performance

Table 1 depicts the means and standard deviations of both performance indicators in dependence of goal condition. Both performance indicators correlated significantly, $r = .57$, $p < .001$. Further, as apparent in Table 1, mean CV change was negative in all three conditions. Thus, in line with past research (Barth & Funke, 2010; Danner, Hagemann, Schankin, et al., 2011; Öllinger et al., 2015), the initial company value decreased over time. Regarding group differences, we expected a main effect of goal type: Participants with learning goals should show higher performance than participants with performance goals (1a) and participants with motto-goals should show higher performance than participants with learning or performance goals (1b). To test the hypotheses, two separate one-way analyses of variance (ANOVA) with goal condition as between-subjects factor and CV change respectively CV trend as dependent variable were calculated⁷. To specify the assumed main effect of goal type, orthogonal contrasts were constructed (see Table 2).

Other than expected, both ANOVAs revealed no significant overall effect of goal condition, both $F(2, 120) < 1$, $n.s.$ ⁸ Thus, hypotheses 1a and 1b were not supported⁹.

Influence of goal type on positive and negative affect

Next, the influence of goal condition on positive and negative affect was analyzed. Figure 2 depicts the affective state of participants in the three conditions at all three times of measurement.

Two separate one-way ANOVAs with goal condition as independent variable and baseline positive respec-

tively negative affect as dependent variable showed that, as expected, participants in the three conditions did not differ in their initial affective state, both $F(2, 120) < 1$, $n.s.$

Influence on affect after goal induction. The second set of hypotheses postulated an interaction between goal type and time: It was assumed that motto-goals increased positive and decreased negative affect more strongly over time than learning or performance goals (2a) and that learning goals increased positive and decreased negative affect more strongly over time than performance goals (2b). We conducted two separate two-way mixed ANOVAs with goal condition as between-subjects factor, time of measurement as within-subjects factor, and the baseline measurement of positive respectively negative affect (T1) as well as the measurement of positive respectively negative affect after goal induction (T2) as dependent variables. Interaction contrasts were constructed to interpret the interaction between goal condition and time of measurement. These contrasts applied the weights depicted in Table 2, but additionally included the factor time. As expected, the interaction between goal type and time was significant for both positive, $F(2, 120) = 5.44$, $p < .01$, and negative affect, $F(2, 120) = 3.83$, $p < .05$. Also the first interaction contrast, comparing motto-goals to the other two goal types over time, was significant for positive, $t(120) = 3.07$, $p < .01$, and negative affect, $t(120) = -2.26$, $p < .05$. This indicated that motto-goal induction indeed led to a higher increase of positive affect and a higher decrease of negative affect than learning or performance goal induction, supporting hypothesis 2a (see Figure 2). Yet, the second interaction contrast, comparing learning to performance goals over time, was not significant and even pointed slightly into the opposite direction for both positive, $t(120) = -1.18$, $p = .24$, and negative affect, $t(120) = 1.58$, $p = .12$. Hence, hypothesis 2b was not supported.

Influence on affect after CPS. Next, affective change due to Tailorshop completion was investigated.

⁶ Without this adjustment results did not change except for one case as reported below.

⁷ Due to the relatively high correlation of CV change and CV trend, a MANOVA was not appropriate.

⁸ The inclusion of gender as second independent variable revealed a significant main effect of gender, $F(2, 116) = 5.15$, $p < .01$. Post-hoc tests with Bonferroni correction showed that men's CV change was slightly less negative, $p = .08$, and men's CV trend was significantly higher, $p < .01$, than women's. Thus, men outperformed women in the Tailorshop on both performance indicators, although the difference regarding CV change was only marginal. However, due to the unequal proportion of male vs. female participants and due to the lack of interaction effects, we collapsed across gender in all analyses.

⁹ Five participants (four of them in the motto-goal condition and one in the performance goal condition) had already performed the Tailorshop before. However, as in all cases this experience was at least six months before study participation and as performance did not differ between groups, we did not further regard prior Tailorshop experience.

Table 1. Means and standard deviations of the two Tailorshop performance indicators in dependence of goal condition.

Goal condition	<i>n</i>	CV change		CV trend	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Motto-goals	42	-94,634.18	107,478.40	2.00	2.74
Learning goals	41	-73,689.14	66,308.13	2.07	3.04
Performance goals	40	-90,105.19	72,625.81	1.65	3.22
Total	123	-86,179.66	84,213.21	1.91	2.98

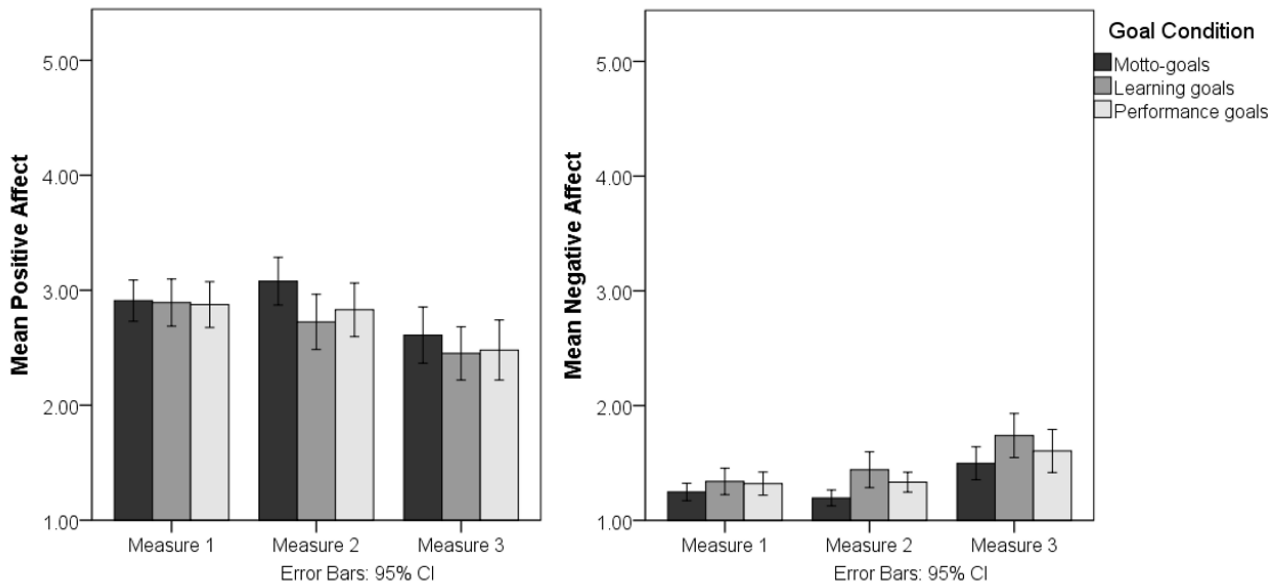


Figure 2. Change of mean positive affect (left side) and negative affect (right side) over the three measurements in dependence of goal condition (motto, learning, performance).

Again, an interaction between goal type and time was assumed: Positive affect should decrease and negative affect increase less over time when participants pursued motto-goals instead of learning or performance goals (3a) and positive affect should decrease and negative affect increase less over time when participants pursued learning instead of performance goals (3b). To test the assumptions, we performed ANOVAs for positive and negative affect that included all three times of measurement. Again, goal condition was applied as independent variable. Unexpectedly, the main effect of time was significant for positive, $F(2, 196) = 24.95, p < .001$, and negative affect, $F(1, 167) = 39.32, p < .001$. This result is not surprising when considering the change of affect over time as depicted in Figure 2. The main effect of goal type was not significant for positive affect, $F(2, 120) = 1.03, p = .36$, but it was significant for negative affect, $F(2, 120) = 3.45, p < .05$ ¹⁰. Contrasts, applying the weights depicted in Table 2, showed that subjects with motto-goals reported significantly lower negative affect than subjects with learning or performance goals, $p < .05$, whereas the difference between participants with learning versus performance goals was not significant, $p = .24$. Unexpectedly, the interaction between goal type and time was not significant for positive, $F(3, 196) = 1.35, p = .26$, as well as negative affect, $F(3, 167) < 1, n.s.$. Thus, groups did not differ in how their affect changed

from the baseline measure to the third measure, so that hypotheses 3a and 3b were not supported. Yet, participants with motto-goals reported the lowest rate of negative affect over time.

Exploratory analyses

Affect and CPS. Apart from the hypothesis testing, we explored the role of affect in CPS. To illuminate this issue, mediational analyses were conducted for positive and negative affect and the two performance indicators. Affect before CPS (after goal induction) served as independent variable, affect after CPS served as dependent variable, and CPS performance served as potential mediator variable. Doing this, the values of participants in all three conditions were aggregated. Because the two performance indicators seem to be causally related (a high number of gain months implies a high final company value and vice versa), a multiple mediator model with both performance indicators seemed inappropriate (Hayes, 2013). The preferred option was to calculate four different models for each of the two performance indicators and for positive and negative affect separately. As the variance of CV change was extremely large compared to the variance

¹⁰When running the analysis without adjusting the outliers regarding negative affect, the main effect of negative affect was only marginally significant, $F(2, 120) = 2.91, p = .06$.

of the other variables, all variables were *z*-standardized beforehand. The significance of indirect effects was tested with the help of bootstrapped 95% confidence intervals (bootstrapping sample = 5000). Figure 3 displays the resulting models including *b*-values and significance levels.

The first and the second mediational model (upper part of Figure 3) tested whether positive affect before and after CPS were related and whether this relationship was mediated by CV change respectively CV trend. Results showed that the direct effect of positive affect before CPS on positive affect after CPS was significantly positive. That is, subjects who experienced positive affect after goal induction were likely to experience positive affect after CPS as well. Furthermore, a high performance regarding CV change and CV trend significantly predicted positive affect after CPS. However, positive affect before CPS did neither predict CV change nor CV trend, so that the indirect effect of positive affect before CPS on positive affect after CPS through performance was not significant either. Hence, performance did not mediate the relationship between positive affect before and after CPS.

The third and the fourth model (lower part of Figure 3) investigated whether the relation between negative affect before and after CPS was mediated by CV change respectively CV trend. The direct effect of negative affect before CPS on negative affect after CPS was again significantly positive. That is, participants who experienced negative affect after goal induction were likely to experience negative affect as well after having completed the Tailorshop. In addition, the relationship between CV change respectively CV trend and negative affect after CPS was significant and negative. Hence, low performance led to comparatively high negative affect. Finally, the influence of negative affect before CPS on Tailorshop performance was marginal for CV change and significant for CV trend. Thus, approaching the Tailorshop with highly negative affect led to low CV trend and low CV change values, which indicates bad performance. The indirect effect of negative affect before CPS on negative affect after CPS through CV trend was small but significant in both models (model 3: $b = .04$, BCa CI [0.01, 0.09], $\kappa^2 = .04$; model 4: $b = .05$, BCa CI [0.02, 0.11], $\kappa^2 = .06$). Thus, the data suggest that the relationship between negative affect before and after CPS was mediated by Tailorshop performance, albeit with a small effect size.

Goal attainment. Last, it was analyzed in an exploratory fashion whether the perceived degree and difficulty of goal attainment and the satisfaction with goal attainment differed across groups. For this purpose, a one-way independent MANOVA with goal condition as independent variable and goal attainment, satisfaction with goal attainment, and difficulty of goal attainment as dependent variables was conducted. The overall effect of goal condition was significant, $F(6, 238) = 3.51$, $p < .01$. Subsequent one-way ANOVAs showed that goal type significantly in-

fluenced all three dependent variables, all $F(2, 120) > 4.34$, all $p < .05$. Bonferroni-corrected post-hoc tests revealed that participants with motto-goals ($M = 5.38$, $SD = 2.52$) reported higher goal attainment than participants with learning ($M = 3.83$, $SD = 1.90$), $p < .05$, and performance goals ($M = 3.55$, $SD = 2.88$), $p < .01$. Furthermore, subjects with motto-goals ($M = 4.95$, $SD = 2.69$) were more satisfied with goal attainment than subjects with learning ($M = 3.39$, $SD = 2.02$), $p < .05$, and marginally more satisfied than subjects with performance goals ($M = 3.63$, $SD = 3.02$), $p = .07$. Last, participants with motto-goals ($M = 6.57$, $SD = 1.85$) judged goal attainment as easier than participants with learning ($M = 7.90$, $SD = 1.36$), $p < .01$, and performance goals ($M = 8.03$, $SD = 1.99$), $p < .001$.

Discussion

The major aim of the present study was to examine the influence of three different goal types – motto, learning, and performance goals – on performance and affect in a CPS task. Other than expected, all three groups performed equally well in the Tailorshop, which might be due to several reasons. First, participants in the motto-goal condition might have lacked enough familiarity with the Tailorshop to develop an appropriate motto-goal that truly helped them to activate necessary resources. Furthermore, goal commitment might not have been high enough to indeed influence performance (e.g., Locke & Latham, 1990; Seijts et al., 2004). Leaving aside motto-goals, the finding that performance goals led to the same performance as learning goals was surprising in the light of the number of past studies that ascribed learning goals an advantage in complex tasks. One plausible explanation for this finding is that most of the previous studies did not use truly complex tasks. Combined with the rather low effect size of the advantage of learning over performance goals in complex tasks (average: $d = -.39$; Seijts et al., 2013), the Tailorshop might have been too complex for learning goals to outperform performance goals. Instead of goal setting, the ability of participants to deal with such tasks might have been a stronger predictor of performance (Locke & Latham, 2002). Furthermore, CPS performance in the present study might be confounded with participants' prior knowledge or intelligence, so that the measurement might have been too unreliable for group differences to gain significance (Kretzschmar, Neubert, Wüstenberg, & Greiff, 2016)¹¹. Last, the estimated power that we actually achieved ($1 - \beta = 0.77$) was slightly lower than the power that we aimed at ($1 - \beta = 0.80$), which might partly explain the missing group differences. However, group differences were so small that they probably still remained insignificant even in the case of a slightly larger sample size.

Although goal type did not affect CPS performance, it did influence the affective state participants re-

¹¹ Thanks to an anonymous reviewer for this remark.

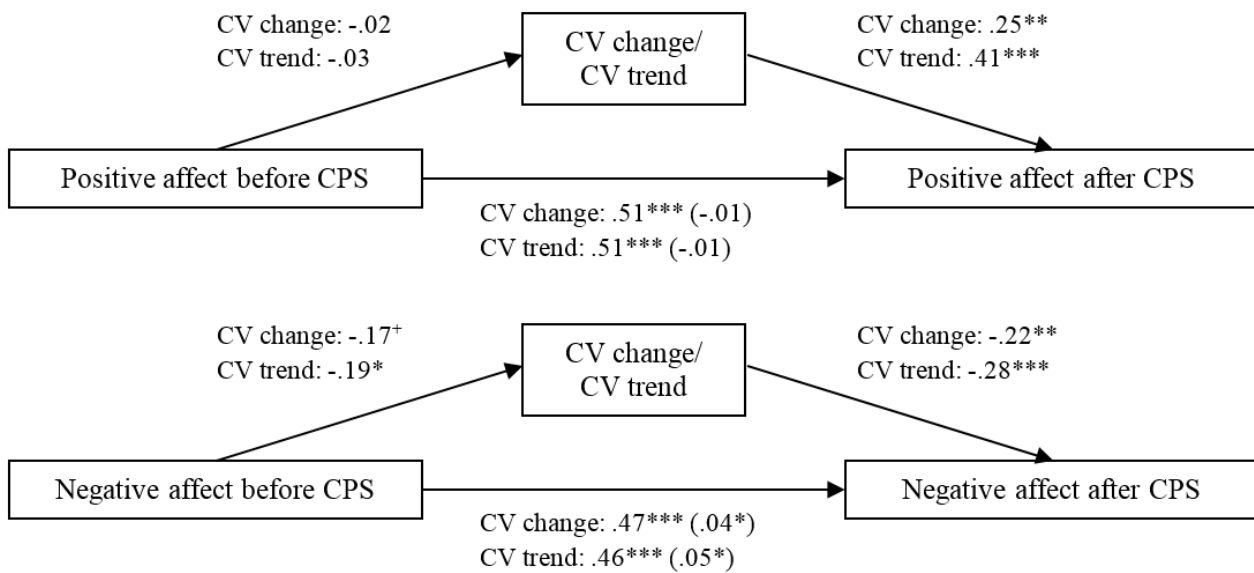


Figure 3. Models of affect before CPS as predictor of affect after CPS, mediated by CPS performance.
 Note. The indirect effect of affect before on affect after CPS through CPS performance is in parentheses.
 + = $p < .10$, * = $p < .05$, ** = $p < .01$, *** = $p < .001$.

ported. The induction of motto-goals led to higher positive and lower negative affect than the induction of the other two goal types. Hence, in accordance with past research, the development of motto-goals seemed to allow for a positive, possibly more optimistic approach towards a complex task. Yet, the affective pattern turned more negative in all three groups in the course of the task, which shows that the advantage of motto-goals did not remain stable over time. Instead, experiences with the Tailorshop might have been similarly frustrating in all three groups, so that motto-goals were not able to buffer against the increase of negative and decrease of positive affect. However, the general increase of negative affect notwithstanding, participants with motto-goals reported significantly lower negative affect than participants with learning goals when aggregating all three measures. Thus, although motto-goals could not completely avoid negative affect in the Tailorshop, they at least reduced it.

Exploratory mediation analyses furthermore showed that – in line with past research – success in CPS increased positive affect, while failure increased negative affect (e.g., Barth & Funke, 2010). This affective response on CPS performance is congruent with common sense: If persons perform well, they feel good and vice versa. The results become more interesting if affect *before* CPS is regarded as well, which in past research delivered ambiguous findings. In the current study, negative affect before CPS negatively predicted performance when all three conditions were aggregated. Thus, subjects completed the Tailorshop more successfully if they approached it with low negative affect. This result at first sight appears to contradict the findings by Barth and Funke (2010). In their study, performance was higher when the Tailorshop’s environment was characterized by bad performance feedback. Con-

sidering that Barth and Funke used the same affect measure (items of the PANAS) and the same CPS task (Tailorshop) as the present study, this discrepancy of results is particularly astonishing. A possible explanation for this contradiction is that both studies applied different designs: Barth and Funke regarded affect as symptom of a nice or nasty environment, whereas the present study regarded affect as symptom of a particular goal induction. The main difference between these two approaches is that in the first case affect was assessed during Tailorshop completion and was likely to be influenced by the ongoing Tailorshop experience, while in the latter case affect was measured before the Tailorshop was started. Furthermore, taking a closer look at the results by Barth and Funke, it was not negative affect per se that increased performance. Rather, nasty environments influenced negative affect as well as CPS performance, but negative affect did not mediate this relationship. Barth’s and Funke’s study and the present findings could be integrated by assuming that persons perform well if they approach the Tailorshop with low aversion, but if they experience negative affect to some degree during task completion, as this can foster a focus on the retrieval of important task information (Spering et al., 2005).

The significant indirect effect in the mediational analyses suggests that the change of baseline negative affect to negative affect after CPS can partly be explained by CPS performance. In other words, persons who approached the Tailorshop with low negative affect performed better, which in turn further decreased their negative affect. Yet, the results of the mediation analysis have to be interpreted cautiously as another reason for the indirect effect might be unreliable measurement of the applied variables (Westfall & Yarkoni, 2016)¹². All in all, the present study suggests that

¹² Thanks to an anonymous reviewer for this remark.

negative affect might be detrimental for task performance. However, as past research did not find a relationship between affect and CPS, further research is required to draw solid inference. Yet, the present results demonstrate the importance of understanding CPS not merely as a cognitive, but also as an emotional and motivational process (cf. Funke, 2003, 2010, 2014).

Furthermore, exploratory analyses revealed that participants with motto-goals judged their goal attainment as higher, easier, and more satisfying than participants with learning or performance goals. These results are in accordance with the fact that high, specific goals can only be reached by a small percentage of a population. Past research has shown that the attainment of personally important goals predicts life satisfaction (Judge, Bono, Erez, & Locke, 2005), subjective and psychological well-being, and even perceived meaning of life (Stauner, 2013). Above that, a long-term consequence of goal attainment might be an increase in self-efficacy. High goal attainment can therefore be seen as further positive feature of motto-goals beyond the positive affective pattern. This way, motto-goals might offer a solution to a goal setting dilemma addressed by Locke (1996), which describes the conflict that high, specific goals can increase performance, but decrease satisfaction: Motto-goals seem to be at least as successful for CPS performance as high, specific goals, and at the same time they avoid the problem of low attainment and satisfaction.

Limitations of the present study

Two main limitations of the present study are important to be mentioned: First, the majority of participants were first semester psychology students with an exceptionally good final exam grade who were most likely highly motivated and ambitious. As we were not able to provide compensation for participation (e.g., in terms of course credit) for non-psychology students, they were not eager to participate. The second limitation refers to the goal manipulation: Even though learning and performance goal manipulation was highly similar, the motto-goal condition differed in some aspects: Motto-goals were developed completely freely, while the other two goal types were based on a specific outcome goal (final company value of at least 250,000/ learning at least 15 relationships between variables), which was specified individually. Resulting group differences might thus be due to a difference in participation in the goal setting process rather than to goal type per se. To minimize this problem, a reflection process was encouraged in all three groups such that participants with learning and performance goals were instructed to consider until when, how, and why they wanted to achieve the goal. An additional limitation is the possibility that participants developed further, self-set goals (e.g., Seijts & Latham, 2011). Although the self-setting of goals probably cannot be prevented, future research might benefit from asking participants after task completion whether they

had developed any additional goal. Furthermore, goals might have varied with regard to their proximity. In most cases, learning and performance goals referred to the last of the 12 months, whereas motto-goals described a general approach from the outset of the Tailorshop. Future research might benefit from controlling for goal proximity, for instance by combining high, specific distal goals with proximal sub-goals (cf. Kozlowski & Bell, 2006; Seijts & Latham, 2001).

Implications for further research

To qualify and extend the present findings, several ideas for further research projects seem promising. First and foremost, the present study mainly tested main and interaction effects to analyze the influence of goal condition on different dependent variables. To better understand the mechanism underlying these relationships, the inclusion of further possible mediator and moderator variables seems important. In this regard, it might be analyzed whether the positive influence of motto-goals on affect is mediated by lower tension when compared to performance or learning goals. Furthermore, the influence of variables like goal commitment, self-efficacy, or action orientation might be of interest. Also an in-depth qualitative analysis of the developed goals could yield insights into mechanisms of goal setting. Second, motto-goals may be tested against high, specific goals in a CPS task participants are well acquainted with. Doing this, motto-goal development could be better based on personal experiences with the task. Third, further research may investigate whether goal setting influences specific discrete emotions (Funke, 2010). For instance, a certain degree of nervousness or anxiousness might be beneficial (cf. Yerkes-Dodson-Law; Yerkes & Dodson, 1908), while shame or hostility seem less adaptive in complex tasks. Beyond, it might be interesting to analyze not only explicit, but also implicit affect, which also seems to be influenced by motto-goals (Weber, 2013). Fourth, further research may apply individual goal orientation as further control variable or analyze the fit between personal goal orientation and external goal setting. For instance, learning goals might be more adaptive if individuals exhibit a stable learning goal orientation. Last, latest research has suggested that the simultaneous use of learning and performance goals can increase performance (Masuda, Locke, & Williams, 2015). Further research may extend these findings by investigating different combinations of goals. For instance, the combination of motto and learning goals might be adaptive in CPS situations.

Practical implications

Bearing in mind that problem solving is one of the key competencies in today's world, the practical relevance of this topic is apparent. Complex technologies are all around, organizations apply complex tasks in personnel selection (Meyer, Grüttig, Oertig, & Schuler, 2009), and even the latest PISA study (Programme for

International Student Assessment) acknowledged the importance of cross-curricular problem solving competencies by incorporating CPS tasks (Funke, 2013b; Greiff et al., 2013). The present study revealed a slight advantage of motto-goals over high, specific goals. Albeit performance did not differ across goal types, motto-goals increased positive and decreased negative affect directly after their induction and helped participants to maintain the low level of negative affect even in the light of frustrating experiences in the Tailorshop. What is more, motto-goals led to a higher degree of and satisfaction with goal attainment, which might positively influence well-being. The present study thus extends the list of situations in which motto-goals can be beneficial. This is especially noteworthy with regard to the fact that high, specific goals enjoy great success not only in research, but also in practice – be it in psychotherapy, in coaching, or in economics. Hidden under the acronym S.M.A.R.T. (specific, measurable, attractive, realistic, terminated), high, specific goals are well-known and are often the first choice in situations where goal setting is relevant (Storch, 2011). The present study further corroborates Storch's argument that the potency of such S.M.A.R.T. goals is limited in complex situations. The advantage of motto-goals might be even more pronounced when considering real-life complex problems in which persons make use of a broad network of past experiences and options for action (Kuhl & Strehlau, 2014).

Apart from goal-setting, the findings regarding the interrelation between CPS performance and affect also have practical implications. The results suggest that approaching a complex problem with highly negative affect lowers task performance. The rather small effect size notwithstanding, this finding might cautiously be transferred to real-world contexts. For instance, working tasks like managing projects, organizing an upcoming event, talking to psychiatric patients, teaching school children, or planning a construction site certainly require complex problem solving skills. The negative relationship between negative affect and CPS performance found in the present study suggests that feelings of frustration or low satisfaction should be avoided when approaching such tasks. The lacking relationship between positive affect and CPS performance shows that it is not required to feel enthusiastic about the upcoming task, but that a rather neutral affective state can be helpful to approach complex tasks successfully. Hence, employers might want to avoid negative affect in their employees – not only to protect people from negative feelings, but also because they might have a direct influence on their task performance.

Conclusion

The present study contributes to CPS research as well as goal setting research by comparing a newly developed goal type – motto-goals – to the well-established high, specific goals in a CPS task. With regard to CPS research, it was tried to shed light on the com-

plex interplay between affect and performance. The results revealed that low negative affect was associated with high CPS performance, emphasizing the role of affective processes in CPS. With regard to goal setting research, it was analyzed whether motto-goals can outperform learning and performance goals in CPS. Against our expectations, CPS performance did not differ across the three goal conditions, which suggests that goal setting exerted a weaker influence than other factors, for instance personal problem solving competencies. Despite that, motto-goals showed a clear advantage over the other two goal types: First, participants with motto-goals perceived their goal attainment as higher, easier, and more satisfying than participants with learning or performance goals. Second, motto-goals animated subjects to approach the Tailorshop with a more positive affective state and to maintain comparatively low negative affect in the course of the possibly frustrating CPS experience. All these results show that motto-goals – even if developed in a short online tool – have the power to encourage persons to approach difficult tasks with a good feeling.

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Author contributions: The authors contributed equally to this work.

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