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Regulating disappointment can impair cognitive performance in kindergarten children: Individual differences in ego depletion

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Cognitive performance can be affected adversely when exerting self-control beforehand; a phenomenon known as ego depletion. The aim of the current study was to examine whether regulation of disappointment impairs cognitive performance in kindergarten children (mean age = 5 years, 6 months). Disappointment was induced by means of a modified version of the disappointing gift paradigm. Ego depletion effects were examined based on two different variables: cognitive performance and behavioral responses. Participants assigned to the experimental condition ($n = 74$) were disappointed before solving a cognitive executive function task. Participants assigned to the control condition ($n = 74$) were not disappointed before solving the cognitive task. Group comparisons (i.e., control group vs. experimental group) showed reduced cognitive performance for the experimental group in terms of accuracy and in terms of speed. Subsequent analyses for the experimental group revealed that only children who expressed appreciative positive emotions when receiving the unwanted gift showed impaired performance on the subsequent cognitive task. Children who expressed negative emotions when receiving the unwanted gift, as well as children who displayed no reaction toward the unwanted gift, did not show impaired cognitive performance. Furthermore, results revealed the crucial role of language for self-regulation skills. Overall, the current results underline the

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importance of taking individual difference in regulation strategies into account when examining ego depletion.

Introduction

Dealing with emotional experiences requires self-regulation. Self-regulation is defined as a multicomponent construct allowing for adaptive and goal-directed behavior (Blair, Raver, & Finegood, 2016; Posner & Rothbart, 2000). Children's self-regulation skills are associated with academic achievement and social competence (Carlson, Mandell, & Williams, 2004; Eisenberg et al., 1995; McClelland, Morrison, & Holmes, 2000) as well as longitudinally with health and general success in life (Moffitt et al., 2011). At the same time, experimental research has revealed that exerting self-control can impair cognitive performance on a subsequent task (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Richards & Gross, 2000). Because self-regulation seems to be a crucial skill during early childhood development, it is important to gain a profound understanding of why cognitive impairment can occur. Thus, the aim of the current study was to examine possible cognitive consequences due to prior exertion of self-control by (a) looking at cognitive performance and (b) taking behavioral responses into account. Although some researchers might argue that self-control is a specific form of self-regulation, the two terms *self-regulation* and *self-control* are often used interchangeably (Baumeister & Vohs, 2007; Hofmann, Rauch, & Gawronski, 2007). Hence, in the current article, we use the two terms interchangeably when referring to volitional goal-oriented behavior.

Emotion regulation refers to all processes that manage, monitor, evaluate, or modify emotional arousal in a manner that facilitates adaptive functioning (Graziano, Reavis, Keane, & Calkins, 2007; Thompson, 1994). The ability to regulate emotions develops substantially during early childhood (Carlson & Wang, 2007). The strategy of emotional suppression belongs to those emotional regulation strategies that have repeatedly been associated with subsequent cognitive costs (Gunzenhauser & von Suchodoletz, 2014; Richards & Gross, 2000). For example, an experimental study showed that preschoolers who were told to suppress their emotional responses while watching emotional movie clips performed worse on a subsequent cognitive task than preschoolers who were not told to suppress their emotions (Gunzenhauser & von Suchodoletz, 2014).

A prominent resource model explaining such impaired performance is the self-regulation model developed by Baumeister and colleagues (Baumeister & Vohs, 2007). The model defines self-control as an inner capacity with only limited internal resources. Exerting self-control consumes these resources, which then are no longer available for a subsequent task. The authors used a muscle metaphor to illustrate the limited resources that, with repeated use, becomes tired, a state denoted as ego depletion. Empirical support for ego depletion comes from experiments using the sequential task paradigm. Usually, participants perform two unrelated self-control tasks. After exerting self-control on the first task, performance on the second task is impaired. Whereas one of the first studies showed that resisting temptation to eat cookies leads to a performance drop in persistence (Baumeister et al., 1998), further research confirmed depletion effects for a broad range of skills. Performance decrements have been found for cognitive skills, such as working memory representation and inhibition, as well as for other skills, such as task persistence and squeezing a handgrip (for a review, see Hagger, Wood, Stiff, & Chatzisarantis, 2010).

However, there are also studies failing to find depletion effects (e.g., Hagger et al., 2016; Stillman, Tice, Fincham, & Lambert, 2009). Because support for the ego depletion effect is not unequivocal, a debate has been opened up about the robustness of depletion effects. Not only does there seem to be underreporting of studies failing to find depletion effects, but also different meta-analyses focusing on statistical strategies to correct for this bias came up with different results with regard to the effect size. The range of the effect sizes stretches from null effects to moderate effects (Carter, Kofler, Forster, & McCullough, 2015; Hagger et al., 2010). Beyond that, there is research showing that depletion effects might be due to depletion of motivation and not to loss of cognitive resources per se (e.g., Dekkers et al., 2017; Huizenga, van der Molen, Bexkens, Bos, & van den Wildenberg, 2012; Muraven & Slessareva, 2003).

There are only few studies that applied the depletion paradigm in young children. Similar to the adult literature, these few studies have produced mixed results. Whereas Gunzenhauser and von Suchodoletz (2014) found evidence for cognitive depletion in 5-year-olds, Peverill, Garon, Brown, and Moore (2017) found depletion effects only for a subgroup of their sample. Depletion effects depended on individual differences in self-control. More precisely, children who would generally engage more in self-control showed depletion effects, whereas children with low self-control skills did not show depletion effects. In addition, Powell and Carey (2017) found that cognitive depletion effects seemed to be robust in 5-year-olds but not in 4-year-olds.

A criticism that has been put forward is that the depletion effect is usually inferred from performance decrements (Hagger et al., 2010; Inzlicht, Schmeichel, & Macrae, 2014). That is, instead of observing the resource depletion directly, performance is compared before and after the self-control task. If performance drops substantially after the self-control task, then ego depletion is assumed. Research from a completely different niche but with a strong focus on individual differences has put forward evidence that children differ in their response to external stimuli. Due to children's differential susceptibility to environmental stimuli, children not only vary in their response to environmental factors but also vary in the degree to which they are affected by environmental factors (Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; Pluess, 2015). Adopting such a point of view to understand the mixed findings reported in the ego depletion literature implies the following: If children are affected differently by the same situation *and* respond differently to the same situation (due to differential susceptibility), it may be informative not only to consider the performance of the self-control task but also to take behavioral responses toward the disappointment into account when examining depletion effects. Therefore, in the current study, we observed children's behavioral–emotional responses during a disappointing situation to gain a more precise understanding of why performance decrements can occur.

The current study

The goal of the current study was to examine whether the regulation of an emotional situation impairs subsequent cognitive performance in 4- to 6-year-olds. An adapted version of the disappointing gift paradigm (Cole, 1986; Saarni, 1984) was applied to elicit an emotional situation for children to regulate. More specifically, children were confronted with a situation of receiving an unwanted unattractive gift. Dealing appropriately with the situation requires emotional regulation strategies (i.e., showing at least some appreciation while at the same time coping with the disappointment; Liebermann, Giesbrecht, & Müller, 2007). In the current study, children assigned to the experimental condition were confronted with the disappointing gift before solving a cognitive executive function (EF) task. Children assigned to the control condition solved the cognitive EF task without first being exposed to a disappointing situation.

The hypotheses for the current study were the following. We expected to find impairments on the cognitive task for children assigned to the experimental condition compared with children assigned to the control condition. In addition, because the emotional suppression strategy has been shown to produce the most reliable cognitive impairments (Richards & Gross, 2000), we expected children masking their disappointment to show the largest cognitive impairments.

Method

Participants

Participants were 148 kindergarten children (mean age = 5 years, 6 months; 47% female). They were predominantly Caucasian and from upper middle-class families, reflecting the characteristics of the local community. Written consent from the children's parents, as well as verbal assent from the children, was obtained before testing. The ethics committee of the local faculty approved the study. An additional 18 participants were tested but needed to be excluded due to technical problems ($n = 4$), outlier control ($n = 2$), very weak language skills ($n = 3$), or missing data ($n = 9$). Of the nine children with missing data, five were dropouts who quit the experiment after receiving the unwanted gift; the other four were ill on the day of the second testing.

Design

The study used a between-subjects design. Participants were randomly assigned to either the experimental condition ($n = 74$; mean age = 5 years, 6 months; 49% female) or the control condition ($n = 74$; mean age = 5 years, 6 months; 45% female).

Experimental condition

We applied an adapted version of the disappointing gift paradigm (Cole, 1986; Saarni, 1984) to urge participants to regulate their emotions. The experimenter presented four different toys to the child, including an unattractive one (i.e., a small rectangular piece of foam). The participant was asked to arrange the toys in a row according to his or her preferences. To verify preferences, the child needed to point to the most preferred one and then to the least preferred one. Then, the toys were set aside and the child needed to solve a labyrinth maze, serving as a filler task before the child received one of the previously rated gifts. To decide which gift would be received, the child was told to pick one of the four cards the experimenter held in her hand. The picture on the back of the card would indicate the gift the child was to receive. Because the lot was manipulated, participants always received the least preferred gift. In a neutral nonsympathetic manner, the experimenter handed the gift to the child and directly introduced the cognitive EF task, namely the Minnesota Executive Function Scale (MEFS; Carlson & Zelazo, 2014).

Childrens verbal expressions and behavioral responses (i.e., gestures and facial expressions) were analyzed and coded for the duration of time between receiving the unwanted gift and the beginning of the instruction of the cognitive task. We categorized the prevailing reaction when receiving the unwanted gift into three broad categories: (a) expression of positive appreciative emotions (verbally and/or behaviorally), (b) expression of negative emotions (verbally and/or behaviorally), and (c) no response (neither verbally nor behaviorally). Two coders rated the responses individually. Interrater reliability was good (intraclass correlation coefficient [ICC] = .98). Due to camera misplacement, behavioral responses could not be coded for three participants. Consequently, these three children were excluded for within-group analyses. For ethical reasons and to control for disappointment being substantial, we offered to exchange the gift after completing the EF task. All children, without exception and without hesitation, exchanged the gift for the most preferred one.

Control condition

As a control task, the experimenter presented four different dice to the child. The child was asked to arrange them in a row according to size. Similar to the experimental condition, the child was asked to point to the biggest dice and to the smallest dice. Then, the dice were set aside and the child was asked to solve the same labyrinth maze as in the experimental condition. Next, the child was introduced to the cognitive task. After task completion, the child was allowed to choose a gift from a range of gifts. The gifts were identical to the ones in the experimental condition.

Measures

Minnesota executive function scale

To assess cognitive performance, the MEFS (Carlson & Zelazo, 2014) was administered. The computerized task was presented on a tablet with a 7.9-inch screen. Children needed to sort cards according to the requested dimension: either color or shape. The EF scale consisted of seven levels with increasing complexity. For each level, there was a Part A and a Part B (with five trials each). On every level, children needed to sort the cards according to one dimension during Part A and switch the dimension for Part B. The starting level was predetermined by age. To move on to the next level, at least 80% of each part (i.e., A or B) needed to be correctly solved. As long as the criterion was accomplished, children continued to higher levels. If participants failed the criterion at the entry level, they were set back until they passed that level. The MEFS is a reliable measure with good retest reliability (ICC = .93; Beck, Schaefer, Pang, & Carlson, 2011). The *adjusted score* served as the main dependent variable (Carlson & Zelazo, 2014; Distefano, Galinsky, McClelland, Zelazo, & Carlson, 2018). The score was calculated based on a software algorithm that combines the highest level passed, the number of correct trials, and the reaction times of correct trials. The score could range from 0 to 100. Analyses were also run with a score that is purely accuracy based, namely the *highest level passed.* The score could range from 1 to 7.

Control measures

To ascertain whether the control group and the experimental group were comparable in terms of their baseline cognitive skills and in terms of their language skills, two control tasks were administered.

Flanker

As a cognitive control task, an age-adapted version of the flanker task was administered (Eriksen & Eriksen, 1974; Rueda et al., 2004). The task was presented on a tablet with a 12.1-inch screen using E-Prime software (Psychology Software Tools, Pittsburgh, PA, USA). Two response buttons were placed in front of the children. Participants were instructed to respond to the orientation of the centrally presented target (fish) by pressing the left or right response button accordingly. In congruent trials, the target and the distractors (four flanking fish, two on each side of the central fish) were facing in the same direction. In incongruent trials, the target and the distractors were facing in opposite directions. The experimental block consisted of 24 trials (12 congruent and 12 incongruent). The stimulus was presented for a maximum of 3500 ms or until children pressed a button. The flanker task shows high retest reliability (ICC = .92; Bauer & Zelazo, 2014). The dependent variable was the percentage of all correct incongruent trials.

Language ability

Language provides a basis for emotion regulation. Empirical work has shown that language abilities and emotion regulation strategies are related given that children can use language as a means to regulate themselves (e.g., Fernyhough & Fradley, 2005; Kopp, 1992). To ascertain that language skills were comparable between the groups, the Test for Reception of Grammar – German Version (TROG-D; Bishop, 1989; Fox-Boyer, 2013) was administered. Out of four pictures, children needed to choose the picture that matched the sentence read out loud by the experimenter. The test has good internal consistency (α = .90) as well as high split-half reliability (r = .91;). The dependent variable was the raw sum score (maximum total score = 21).

Procedure

All tests were administered individually by trained experimenters. Testing took place in a separate room at the kindergarten. All children were tested twice in total but on two separate days to rule out carryover effects from disappointment on control tasks and vice versa. The order of the tasks was fixed, but sessions were counterbalanced between participants. For Session A, the disappointing gift paradigm or the control task (i.e., dice ordering) and a cognitive EF task (i.e., MEFS) were administered. For Session B, a cognitive control task (i.e., the flanker task) and language skills (TROG-D) were assessed. Both sessions were videotaped. Table 1 provides descriptive data for all variables.

Table 1
Descriptive statistics.

	Experimental group			Control group
	Negative emotions	Positive emotions	Neutral	
n	25	22	24	74
Age (months)	69.0 (6.8)	67.4 (7.1)	64.9 (7.1)	67.0 (7.1)
Female (%)	36.0	50.0	58.3	44.6
MEFS				
Adjusted score	53.7 (10.5)	47.5 (5.7)	48.3 (8.9)	53.9 (12.5)
Control tasks				
ACC Flanker (%)	82 (20)	87 (17)	85 (22)	80 (23)
TROG-D	4.4 (2.0)	4.4 (1.7)	4.1 (1.4)	4.3 (1.6)

Note. Standard deviations are in parentheses. Interrater reliability for behavioral coding: intraclass correlation coefficient = .98. MEFS, Minnesota Executive Function Scale. ACC Flanker, accuracy scores are reported in %. TROG-D, Test for Reception of Grammar - German Version.

Statistical analysis

All statistical analyses were run with SPSS Statistics Version 25.0 (IBM, Armonk, NY, USA). For the MEFS, participants exceeding the interindividual mean by more than three standard deviations were considered as outliers and, therefore, were excluded ($n = 2$). For the flanker task, reaction times of less than 150 ms, as well as reaction times exceeding the inter- and intraindividual mean by more than three standard deviations, were considered as outliers and, therefore, were excluded (pertained to 2.3% of all data points).

To ascertain whether the two groups were comparable, mean comparisons for all control variables were run. Between the two groups, there were no differences in terms of age, $F(1, 147) < 1$, $p = .82$, $\eta_p^2 = .00$; gender, $\chi^2(1) = 0.24$, $p = .74$; language (TROG-D), $F(1, 147) = 2.96$, $p = .10$, $\eta_p^2 = .01$; or inhibitory control (flanker), $F(1, 147) = 1.54$, $p = .22$, $\eta_p^2 = .01$.

Results

Cognitive performance differences between the control conditions

An analysis of variance (ANOVA) was run to examine cognitive performance differences between the control group and the experimental group. The ANOVA revealed a significant main effect for group: MEFS adjusted score, $F(1, 147) = 4.75$, $p = .03$, $\eta_p^2 = .03$. The identical analysis for the accuracy variable revealed very similar effects: MEFS highest level passed, $F(1, 147) = 4.63$, $p = .03$, $\eta_p^2 = .03$. Thus, children in the control group outperformed their peers in the experimental group on the cognitive task.

Cognitive performance differences within the experimental group

Based on the reaction when receiving the unwanted gift, participants were categorized into one of three subgroups: positive reaction, negative reaction, or no reaction. To ascertain that within-group differences could not be explained otherwise, the three groups were compared in terms of all control variables and background variables. No differences could be found for any of the variables: age, $F(2, 70) = 2.12$, $p = .13$, $\eta_p^2 = .06$; gender, $\chi^2(2) = 2.50$, $p = .28$; language (TROG-D), $F(2, 70) = 1.90$, $p = .16$, $\eta_p^2 = .05$; or inhibitory skills (flanker), $F(2, 70) < 1$, $p = .72$, $\eta_p^2 = .01$.

To examine cognitive performance differences among the three groups, a further ANOVA was run. The analysis revealed a significant main effect for group: MEFS adjusted score, $F(2, 70) = 3.67$, $p = .03$, $\eta_p^2 = .10$. The analysis for the accuracy variable highest level passed did not reach statistical significance anymore, $F(2, 70) = 2.67$, $p = .08$, $\eta_p^2 = .07$. Subsequent post hoc comparisons for the adjusted score variable revealed a significant performance difference between the group that expressed negative emotions and the group that showed positive emotions ($p = .04$, confidence interval [CI] = 0.04–12.48). More precisely, children expressing positive emotions when receiving the unwanted gift performed substantially worse on the cognitive task compared with their peers expressing negative emotions. None of the other possible comparisons reached statistical significance. Thus, it seems that particularly children expressing positive appreciative behavior were depleted, yielding in impaired cognitive performance on the subsequent MEFS task.

As a final step, a covariate analysis was run to examine the impact of language, age, and gender on the observed depletion effect. The assumption of independence of covariate and experimental effect and the assumption of homogeneity of regression slopes were met (Miller & Chapman, 2001). The analysis revealed that once language was included as a covariate, the (previously found) main effect group was no longer significant, $F(2, 70) = 1.71$, $p = .19$, $\eta_p^2 = .05$. Language, however, was a significant covariate, $F(1, 70) = 7.42$, $p = .01$, $\eta_p^2 = .14$. Age, $F(1, 70) = 2.58$, $p = .11$, $\eta_p^2 = .04$, and gender, $F(1, 70) < 1$, $p = .78$, $\eta_p^2 = .00$, were nonsignificant covariates. The results indicate that language seems to play an important role in self-regulatory behavior.

Discussion

The aim of the current study was to examine whether the regulation of disappointment impairs cognitive performance in kindergarten children. First, we analyzed overall group differences between the experimental group and the control group. Second, we analyzed differences within the experimental group. Overall, compared with the control group, the experimental group showed impaired cognitive performance after being disappointed. Analyses for the experimental group revealed that children who expressed positive appreciative behavior when receiving the unwanted gift showed impaired performance on the subsequent cognitive task. Children expressing negative emotions or frustration when receiving the unwanted gift, as well as children showing no response toward the unwanted gift, did not show impairments on the cognitive task. In addition, results further revealed the crucial role of language for self-regulation skills. In the remainder of this section, we focus on three different aspects. First, we discuss how the current results add to the equivocal depletions effects reported in the literature. Second, we consider the role of language for self-regulation skills. Third, we discuss the results with regard to self-regulation skills of kindergarten children.

The current results dovetail nicely with the contradictive results reported in the ego depletion literature. The group comparison between the experimental group and the control group would generally lead to the assumption that the entire experimental group was depleted. However, the within-group analysis for the experimental group revealed a more refined picture. For the within-group analysis, we not only used performance as an estimate for depletion but also took behavioral responses when receiving the gift (i.e., expression of positive, negative, or no emotions) into account. Thus, by not only inferring depletion based on performance decrements but also considering behavioral response patterns, the results suggest that depletion effects occurred for only a subgroup of the sample. The effect was found only for the adjusted score but not for the accuracy score. Consequently, the results suggest that depletion predominantly compromised response speed but not accuracy. However, accuracy is not as sensitive to individual differences as the adjusted score, which may also explain why the effect was only found for the adjusted score. Overall, the current results provide an example of how ego depletion effects can be misinterpreted if only overall group comparisons are considered and individual differences are neglected (Hagger et al., 2010; Inzlicht et al., 2014).

Previous research with similar age groups has also revealed depletion effects for subgroups of the samples. Whereas an experimental study reported depletion effects being age related (Powell & Carey, 2017), Peverill et al. (2017) found depletion effects only for those participants who had generally high self-control skills. The current findings are in line with Peverill et al.'s findings; namely, children who were able to mask their disappointment to the extent that they expressed appreciative positive emotions showed the strongest cognitive impairments. Although we did not quantify children's self-control skills, we believe that for a kindergarten child masking disappointment to the extent of expressing appreciative behavior demands good self-control skills. It seems that not only suppressing emotional reactions (Gunzenhauser & von Suchodoletz, 2014) but also masking disappointment to the extent of expressing positive emotions leads to impaired cognitive performance. However, one could argue that children expressing positive emotions were not sufficiently disappointed by the unwanted gift and, therefore, did not need to mask disappointment. Although we cannot fully rule out this possibility, we controlled whether children would have preferred something else in the first place. More specifically, after completing the cognitive task, children in the experimental condition were given the opportunity to exchange the gift - an exchange that all children opted for without hesitation. Nevertheless, a limitation of the current study is the lack of a quantified measure for the severity of disappointment. Beyond that, it is also possible that performance decrements stemmed from reduced motivation. It might be that children showing appreciative behavior when receiving the unwanted gift were simply less motivated to perform well on the subsequent cognitive task. Therefore, in a future research design, it would be necessary not only to quantify severity of disappointment but also to address motivational factors (Dekkers et al., 2017; Huizenga et al., 2012; Muraven & Slessareva, 2003).

The final analysis revealed that, compared with the experimental manipulation, language was the better predictor to explain group differences in EF. When interpreting this result, it should be kept in mind that there were no baseline group differences between the groups either in terms of cognitive EF skills or in terms of language. In addition, there is a line of evidence showing strong associations between language and self-regulation (e.g., Fatzer & Roebers, 2013; Vallotton & Ayoub, 2011) and empirical work conceptualizing language as a means for children to regulate themselves (Cole, Armstrong, & Pemberton, 2010; Winsler, Carlton, & Barry, 2000). Hence, children with better language skills have more diverse strategies available to regulate themselves in challenging situations. Based on such previous findings, we interpret the current results as follows. Because language can serve as a regulatory strategy, it is possible that children with good language skills had more self-regulatory strategies available to regulate themselves. Thus, cognitive performance differences between the groups disappeared once a regulation strategy (i.e., language) was included in the analysis. Obviously, based on the current data, such an interpretation is highly speculative. Thus, more comprehensive experimental research designs are needed to examine the complex relation among language, self-regulation, and possible depletion effects.

To wrap up, on the one hand, it seems important to consider different variables such as behavioral responses along with performance decrements when interpreting depletion effects. On the other hand, taking individual differences in the ability to deal with a particular situation (i.e., self-regulation strategies) into account may be helpful to further understand the complex interactions in depletion processes. Overall, effect sizes were rather small and the statistical power was rather low. Therefore, it would be necessary to replicate the current findings, possibly as a preregistered study and with a larger sample size, to further estimate the robustness of the current findings.

If we return to the initial question of whether regulation of disappointment impairs cognitive performance, the answer cannot be a straightforward one. Foremost, because in Western societies it is considered appropriate to express appreciation when receiving a gift (including an unwanted one) from a casually known adult (i.e., the experimenter). Children who showed appreciation in the sense of expressing positive emotions when receiving the gift showed cognitive impairment on the subsequent task. In comparison, children who showed a response that was not situation appropriate (i.e., verbally and/or nonverbally expressing negative emotions) performed better on the subsequent task. The way in which these children regulated their emotions might not be particularly appropriate in terms of politeness and adaptivity, but they found a way of expressing their disappointment that did not affect their cognitive performance on the subsequent task.

These findings lead to a further discussion about different regulation strategies being beneficial with regard to long-term and/or short-term consequences. However, without even considering the findings with regard to language, the question addressing ideal regulation strategies is a difficult one. With regard to the cognitive outcome, we should argue that in the current study, children who expressed their frustration were the better regulators. However, in terms of socially acceptable behavior, these children would not have qualified as "good regulators." Thus, for self-regulation research, it might be worthwhile to move beyond the categories of "good" and "bad" regulation skills and to instead observe which regulation strategies are related to which outcomes in different situations. In addition, perhaps jointly considering information on behavior and outcome might help to advance the understanding of the complex interactional processes taking place in self-regulated behavior.

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