



The Influence of Learners' Reading-Related Hope or Hopelessness and Recue Instructions on Text Comprehension and Metacomprehension

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Abstract: In this experimental study with 62 university students, we examined to what extent the hope or hopelessness they experience during reading a text affect their comprehension as well as the magnitude and accuracy of their predictions and postdictions. Moreover, we investigated whether the impact of the emotional state varies with a recue instruction that explicitly indicates the limited validity of emotions as judgment cues. The results showed that the students used their experienced hope or hopelessness to make predictions and postdictions. This effect did not differ depending on whether they had received the recue or a control instruction. However, when students received the control instruction, greater hopelessness impaired comprehension, whereas this was not the case with the recue instruction. Finally, the instruction type did not play a moderating role in the influence of the emotional state on prediction and postdiction accuracy. Yet, concerning postdiction accuracy, students who received the recue instruction were more accurate.

Keywords: hope and hopelessness, metacomprehension, reading, text comprehension

Der Einfluss von lesebezogener Hoffnung oder Hoffnungslosigkeit und Recue-Instruktionen auf das Textverständnis und Metaverständnis

Zusammenfassung: In dieser experimentellen Studie mit 62 Studierenden wurde untersucht, inwiefern die Hoffnung oder Hoffnungslosigkeit, die diese beim Lesen eines Textes empfinden, ihr Verständnis sowie die Höhe und Genauigkeit ihrer Prädiktionen und Postdiktionen beeinflusst. Darüber hinaus wurde untersucht, inwiefern der Einfluss des emotionalen Zustands von einer Recue-Instruktion abhängt, welche explizit darauf verweist, dass Emotionen keine validen Einschätzungsgrundlagen darstellen. Die Ergebnisse zeigten, dass die Studierenden ihre empfundene Hoffnung oder Hoffnungslosigkeit heranzogen, um Prädiktionen und Postdiktionen zu treffen. Dieser Effekt unterschied sich nicht abhängig davon, ob diese die Recue-Instruktion oder eine Kontrollinstruktion erhielten. Wenn Studierende die Kontrollinstruktion erhielten, beeinträchtigte eine größere Hoffnungslosigkeit allerdings das Verständnis, während dies mit der Recue-Instruktion nicht der Fall war. Schließlich spielte die Instruktionsart keine moderierende Rolle für den Einfluss des emotionalen Zustands auf die Genauigkeit der Prädiktionen und Postdiktionen. Studierende, die die Recue-Instruktion erhielten, trafen jedoch genauere Postdiktionen.

Schlüsselwörter: Hoffnung und Hoffnungslosigkeit, Lesen, Selbsteinschätzungen, Textverständnis

From the last years of primary school on, acquiring knowledge from texts becomes a main learning activity. To successfully learn from texts, learners must comprehend the contents. In addition, they must monitor and accurately judge their comprehension, a skill termed *metacomprehension accuracy*. Accurate metacomprehension is crucial to effective regulation and improving one's comprehension (e.g., Dunlosky & Rawson, 2012; Thiede et al., 2003). Research has widely investigated factors that may affect metacomprehension judgments and their ac-

curacy. For example, in addition to factors related to the learning material, such as the variety of the text topics, researchers have examined cognitive factors, such as prior knowledge, and motivational factors, such as self-efficacy (e.g., Golke et al., 2022; Prinz et al., 2020a). Although emotions play a central role in learning settings, only a few studies have explored the influence of emotional factors (Prinz et al., 2019; Prinz-Weiß et al., 2022). In particular, hope and hopelessness often occur in learning settings (e.g., Pekrun et al., 2002, 2011) and have

been found to play a role in self-regulation processes (Burić & Sorić, 2012). Thus, in the present study, we investigated to what extent the hope or hopelessness that learners experience during reading a text affect their comprehension, metacomprehension judgments, and metacomprehension accuracy. Moreover, we examined whether instructions that explicitly indicate the limited validity of emotions as indicators of one's comprehension and point toward more valid judgment bases would counteract the potential impact of the emotional state.

The Antecedents and Effects of Achievement Emotions

Emotions are multifaceted constructs that include physiological, affective, cognitive, motivational, and expressive components (e.g., Frijda, 1986). Emotions particularly related to achievement activities or outcomes have been termed *achievement emotions*. The differentiation of activity versus outcome pertains to the object focus of achievement emotions. In addition, one can group achievement emotions according to the dimensions of valence (positive vs. negative) and activation (activating vs. deactivating; e.g., Pekrun, 2006). For example, hope is a positive activating emotion, relief a positive deactivating emotion, anxiety a negative activating emotion, and hopelessness a negative deactivating emotion.

The control-value theory of achievement emotions (e.g., Pekrun, 2000, 2006) provides an integrative framework for analyzing the antecedents and effects of achievement emotions. Concerning the antecedents, cognitive appraisals of control and value are considered the main determinants of learners' achievement emotions. Specifically, learners' perception of control over learning activities or outcomes and of the value of these activities or outcomes arouse the discrete emotional state. For example, if learners perceive themselves to have moderate control over their performance and value studying the material, they will likely experience hope; if learners perceive themselves to have low control over their performance, while studying the material is of some subjective value, they might feel hopelessness (e.g., Burić & Sorić, 2012; Pekrun, 2006; Shao et al., 2020).

Concerning the effects of achievement emotions, the control-value theory suggests that they have differential effects depending on their valence and activation. Whereas the effects of deactivating-positive emotions (e.g., relief) and activating-negative emotions (e.g., anxiety) are more ambivalent, mostly activating-positive emotions (e.g., hope) support and deactivating-negative emotions

(e.g., hopelessness) impair cognitive resources, motivation, and performance (e.g., Camacho-Morles et al., 2021; Pekrun, 2006; Pekrun et al., 2002). Regarding hope and hopelessness in particular, several previous studies indicated that hope typically positively impacts academic performance, while hopelessness usually has a detrimental influence on academic performance (e.g., Burić & Sorić, 2012; Peixoto et al., 2017; Shao et al., 2020). In academic situations, if students experience hopelessness, they might lack motivation and invest little effort in their learning, which in turn harms their performance. In contrast, hope might strengthen their motivational and cognitive resources and thus support their performance (e.g., Daniels et al., 2009; Pekrun et al., 2002). Furthermore, hope and hopelessness have been found to affect self-regulation processes. Specifically, in mathematics, Burić and Sorić (2012) explored the relationships of students' test-related hope and hopelessness with academic achievement and volitional strategies, which are strategies to regulate one's motivation and affect. The results indicated that, in addition to the detrimental effect of hopelessness on school success, hope and hopelessness were associated with volitional strategies. More precisely, higher levels of hope and lower levels of hopelessness were related to stronger use of self-efficacy enhancement (e.g., self-encouraging) and stress-reduction strategies (e.g., support seeking) and to reduced use of negative-based incentives (e.g., thinking about one's parents' disappointment).

The Role of Hope and Hopelessness for Text Comprehension and Metacomprehension

Successful text comprehension requires learners to actively process the textual information and construct a mental representation of it (e.g., Kintsch, 1998). The evidence is rather scarce concerning the influence of achievement emotions on text comprehension. However, the existing evidence suggests that, in most instances, positive emotions support and negative emotions impair comprehension (Ainley, Hidi, et al., 2002; Ainley, Hillman, et al., 2002; Miesner & Maki, 2007; Prinz-Weiß et al., 2022; Zaccoletti et al., 2020). Zaccoletti et al. (2020) investigated trait achievement emotions learners feel when engaging in reading comprehension activities. Their results revealed that negative activating and deactivating emotions were related to poorer comprehension. The association of positive emotions with comprehension tended to be positive but small. Similarly, a study by

Prinz-Weiß et al. (2022) on state achievement emotions learners experienced while reading a text showed that negative emotions, namely, anger, hopelessness, and negative emotions overall, were detrimental to comprehension. In contrast, positive emotions, namely, enjoyment, hope, and pride, had no impact. In summary, although there is only a little research on the impact of hope and hopelessness in particular and the effects of positive achievement emotions seem less clear, the existent research suggests that the experience of a higher degree of hopelessness – and accordingly a lower degree of hope – might be a barrier to comprehension.

When one learns from texts, in addition to achieving good comprehension, one needs accurate metacomprehension. More accurate metacomprehension results in more effective regulation, such as concerning decisions about which contents to reread, and in turn to enhanced comprehension (e.g., Dunlosky & Rawson, 2012; Thiede et al., 2003). However, learners' metacomprehension is often inaccurate, particularly regarding predictions, which are judgments provided after reading but before testing, as they tend to be overconfident (e.g., Maki et al., 2005). Postdictions, which are judgments provided after testing, are typically more accurate (e.g., Pierce & Smith, 2001) or even underconfident (e.g., Prinz et al., 2019). The role of achievement emotions for metacomprehension judgments and their accuracy has not received much attention in research either. Miesner and Maki (2007) found that learners with higher state anxiety reported after reading a text made lower predictions. The impact of anxiety on postdictions and the accuracy of predictions and postdictions was not examined. A study by Prinz-Weiß et al. (2022) was the first to investigate how various reading-related positive and negative state achievement emotions, in addition to anxiety, affect metacomprehension judgments and accuracy. The results revealed that stronger positive emotions, that is, enjoyment, hope, pride, and positive emotions overall, were related to higher predictions and postdictions, and that stronger negative emotions, specifically, anger, anxiety, shame, hopelessness, boredom (only marginally significant for predictions), and negative emotions overall, were related to lower predictions and postdictions. Regarding prediction accuracy, stronger positive emotions, including enjoyment, hope, pride, and positive emotions overall, were associated with greater overconfidence, and stronger negative emotions, namely, anxiety, shame, and hopelessness, with greater underconfidence. Concerning postdiction accuracy, stronger positive emotions, particularly enjoyment, hope, pride, and positive emotions overall, were associated with less underconfidence, and stronger negative emotions, namely, anxiety and shame, with greater underconfidence. Notably, in relation to the other positive and

negative achievement emotions assessed in this study, the effects of hope and hopelessness on metacomprehension judgments and accuracy were comparatively strong. However, when interpreting the results, it should be taken into account that the learners in the study did not experience high levels of negative emotions. The cue-utilization framework has been applied to explain the findings (Griffin et al., 2009; see also Koriat, 1997). According to this framework, when making judgments, learners infer their level of comprehension based on available information, known as cues. Depending on the validity of the cues, that is, on how strongly they are related to actual comprehension performance, learners' judgments turn out more or less accurate. Heuristic cues, such as familiarity with the learning domain, usually do not closely relate to comprehension performance for a specific text and therefore rather yield inaccurate judgments (e.g., Glenberg et al., 1987). Representation-based cues, such as accessibility of textual information, are generally more closely related to comprehension performance for a specific text and thus produce more accurate judgments (e.g., Baker & Dunlosky, 2006). The findings by Prinz-Weiß et al. (2022) suggest that learners use the achievement emotions they experience during reading as cues for making predictions and postdictions about their comprehension. However, the emotions rather represent heuristic cues. Although positive achievement emotions are sometimes associated with better comprehension and negative achievement emotions with poorer comprehension, this is not regularly the case – especially for positive emotions (e.g., Prinz-Weiß et al., 2022; Zaccoletti et al., 2020). In addition, learners might misjudge the predictive value of emotions when making judgments. More precisely, even if positive achievement emotions are related to better comprehension, and negative achievement emotions to poorer comprehension, learners might over- or underrate the extent to which this is the case (see also Prinz-Weiß et al., 2022). In conclusion, reading-related achievement emotions do not necessarily represent valid cues and can therefore lead to inaccurate metacomprehension.

The Instructional Method of Reattribution

Reattribution is a method that might prove useful for reducing learners' reliance on their achievement emotions as cues. Attributions refer to causes that individuals use to explain events. Individuals make attributions all the time to make sense of life experiences. However, attribu-

tions involve an individual's subjectively perceived causes and are therefore not necessarily accurate but can be unrealistic and dysfunctional. For example, in achievement settings, if a student fails on an important test and attributes the failure to an invariable lack of ability, the student experiences negative emotions and expects further failure, diminishing motivation and performance (e.g., Heider, 1958; Weiner, 1974). Fortunately, attributions can be modified. A way to do so is reattribution, which aims at redirecting attributions toward more realistic and adaptive causes and as such has been widely used in educational, social, and clinical contexts (e.g., Banerjee et al., 2020; Perry et al., 2014).

There are different reattribution techniques. One technique is to inform individuals explicitly about the desired attributions. For example, one can instruct students that failure is often the result of a lack of effort that can deliberately be exerted instead of the result of stable, uncontrollable causes such as ability. This can induce positive expectations about future success and motivate learners to invest effort to achieve good performance (e.g., Perry et al., 2014; Ziegler & Schober, 2001). In general, reattribution techniques in educational contexts often first prompt learners to search for causes for their successes and failures in order to activate maladaptive attributions and draw their attention to the reattribution information that emphasizes legitimate causes. Research has comprehensively shown that reattribution is effective in learning settings (e.g., Perry et al., 2014). Hence, transferring reattribution techniques to affect learners' use of cues for judging their comprehension might be a promising avenue.

The Present Study

Hope and hopelessness often occur in learning settings (e.g., Pekrun et al., 2002, 2011). However, little research has been conducted on the effects of hope and hopelessness on learners' text comprehension and metacomprehension so far, with the available evidence suggesting that their effects are comparatively strong (e.g., Prinz-Weiß et al., 2022). Moreover, there is a lack of methods to help learners not rely on their achievement emotions when judging their comprehension but use more valid cues. In this study, we examined to what extent the hope or hopelessness that learners experience while reading a text affect their comprehension, metacomprehension judgments (i.e., predictions and postdictions), and metacomprehension accuracy regarding bias, which indicates over- and underconfidence. In addition, we investigated the impact of a recue instruction compared with a control

instruction on the effects of the emotional state. The recue instruction explicitly stated that emotions are not necessarily valid indicators of one's comprehension, and that therefore, when judging one's comprehension, one should not rely on them but carefully consider how good one's understanding of the central text messages actually is.

Based on previous findings on the role of achievement emotions and in particular of hope and hopelessness for learning from texts (e.g., Prinz-Weiß et al., 2022; Zaccolletti et al., 2020), and on the effectiveness of reattribution techniques (e.g., Perry et al., 2014), we tested the following assumptions:

We expected higher hopelessness (i.e., lower hope) to be associated with poorer comprehension – at least with the control instruction. Concerning the impact of the recue instruction, we had no clear hypothesis because it targeted learners' judgmental rather than comprehension processes (comprehension research question).

Furthermore, we assumed that, with the control instruction, higher hopelessness (i.e., lower hope) would lead to lower predictions (prediction hypothesis) and postdictions (postdiction hypothesis), whereas these associations should be diminished with the recue instruction.

Concerning the accuracy of predictions, we expected that, with the control instruction, higher hopelessness (i.e., lower hope) would relate to lower bias scores (i.e., greater underconfidence) compared with lower hopelessness (i.e., higher hope), which would relate to higher bias scores (i.e., greater overconfidence), but that this effect would decline with the recue instruction (prediction-accuracy hypothesis).

Concerning the accuracy of postdictions, we expected that, with the control instruction, higher hopelessness (i.e., lower hope) would relate to lower bias scores (i.e., greater underconfidence) compared with lower hopelessness (i.e., higher hope), which would relate to higher bias scores (i.e., less underconfidence or greater accuracy), but that this effect would decline with the recue instruction (postdiction-accuracy hypothesis).

Methods

Sample and Design

We estimated the minimum sample size required for our study by conducting a power analysis with the software G*Power (Faul et al., 2007). We expected to find medium effects in our study based on research that revealed medium effects of reattribution interventions (e.g., Perry et al., 2014). The analysis revealed that we would need a

sample of 55 participants to detect a statistically significant moderation effect (Cohen's $f^2 = 0.15$, $\alpha = .05$, power = .80, total number of predictors = 3, two-tailed). To compensate for potential dropouts, we collected data from $N = 62$ university students. The students had their majors in the fields of the humanities and social sciences (educational science: 54.8%, psychology: 11.3%, cultural studies: 9.7%, cognitive science: 8.1%, a foreign language: 6.5%, philosophy: 4.8%, economy: 3.2%, sociology: 1.6%). To prevent participants with profound prior knowledge on the topic of the text to be studied (i. e., heat pumps), we excluded students studying physics or related natural science subjects. In addition, we excluded students with an existing emotional strain or psychological impairment. On average, the participants were in their 4.00 ($SD = 1.85$) semester and were 22.26 ($SD = 5.09$) years old. 77% were female, 23% male, and none nonbinary. Participants received either course credit (1 hour) or pay (€ 10) for participating in the study.

The study was conducted online and had an experimental design with two predictor variables. The predictor variable “instruction type” functioned as a moderator and was manipulated between participants. They were randomly assigned to the recue ($n = 31$) or control ($n = 31$) condition. The predictor variable “hope/hopelessness” was experimentally manipulated by randomly inducing one of three emotional states: hope ($n = 22$), hopelessness ($n = 20$), or neutral ($n = 20$). This manipulation aimed to obtain a larger variation in participants’ emotional experience because, in previous research, participants had not felt high degrees of negative emotions (Prinz-Weiß et al., 2022). Therefore, rather than using a categorical variable comprising the three conditions, we used participants’ actually experienced hope/hopelessness during reading as a continuous variable. In this way, we also avoided losing information and statistical power. Comprehension, metacomprehension judgments, and metacomprehension accuracy were the dependent variables. The study was approved by the Ethics Committee of the university the authors were affiliated with.

Material

Emotion Induction

For the emotion induction, we formulated instructions based on the control-value theory (Pekrun, 2000, 2006; see also Burić & Sorić, 2012; Shao et al., 2020). According to the theory, the perceived control over and the subjective value of learning activities or outcomes determine which emotions occur. To arouse a high value of the learning topic, in all three conditions, we emphasized that knowledge about heat pumps is of high relevance because

renewable energies play an important role in our environment and everyday lives. Moreover, in all three conditions, the participants were informed that the text they were about to receive on the physical topic of heat pumps had already been used in a previous study. Participants in the hopelessness condition were told that the students in the previous study had difficulty understanding the text because of the relatively high complexity of the contents, which are hard to grasp without expertise in the field even with a high cognitive effort. In this way, participants in this group should perceive that they have low control over their comprehension performance, which together with a high value should lead to an experience of hopelessness. In contrast, participants in the hope condition received the information that the students in the previous study had no difficulty understanding the text because of the relatively low complexity of the contents, which can be comprehended well even without expertise in the field with a little cognitive effort. Participants in this group should therefore perceive that they have some control over their comprehension performance, which, in combination with a high value, should result in an experience of hope. In the neutral condition, we explained that the students in the previous study read and processed the contents differently, perhaps because of differences in existing cognitive schemata or attitudes. Hence, we did not manipulate perceived control in this group. The instructions for the hope and hopelessness conditions both comprised 118 words and for the neutral condition 117 words.

Recue Instruction

We formulated the recue instruction based on research on reattribution techniques in learning settings (e. g., Perry et al., 2014). The recue instruction explicitly informed participants about the desired judgment processes. First, it was explained that research has revealed that learners tend to use their emotions to make judgments, such as concerning their text comprehension, in such a way that positive emotions rather lead to high and negative emotions to low judgments. This was done to activate this possible relationship in participants’ memory and draw their attention to the subsequent information. Next, the instruction emphasized that emotions are, however, not reliable resources for drawing inferences about one’s comprehension, and that they therefore should not use them for making comprehension judgments. Instead, they should consider how good their understanding of the central text messages actually is. The control instruction explained that research has revealed that reading at a fast pace, so-called speed-reading, can impair comprehension because the textual information is not processed properly. Then, the instruction emphasized that it is more reason-

able to train one's language skills, such as vocabulary or reading fluency, to read texts faster without impairments to comprehension. Participants were told that therefore they should not engage in speed-reading but take the time needed to understand a text's central messages. Both instruction types comprised 162 words.

Text

The expository science text used in this study dealt with the physical topic of heat pumps and included 633 words. The text had a Flesch-Reading-Ease score of 38, which indicates that the text was rather difficult to read. We chose the level of difficulty so that it was sufficiently demanding for the participants. The text described areas of application, processes, refrigerators, efficiency aspects, and pros and cons concerning heat pumps.

Measures

Prior Knowledge

We assessed prior knowledge with one open-ended question that asked participants to write down everything they knew about heat pumps. They received 0 points if no or an incorrect answer was given. They received 1 point for providing a rough definition of what heat pumps are, explaining some processes occurring in heat pumps, or indicating utility aspects of heat pumps. They received 2 points for giving a more detailed explanation of the processes or for providing at least two of the above-mentioned aspects (i.e., definition, processes, utility). Two raters independently scored the participants' answers with high interrater agreement, Cohen's $\kappa = .86$, 95% CI [0.66, 1.00].

Emotional State

We assessed participants' state hope and hopelessness with the Achievement Emotions Questionnaire (Pekrun et al., 2011). The questionnaire provides 3 items for assessing hope and 5 items for assessing hopelessness related to learning. We applied the items twice, once directly after the emotion manipulation and once after reading. We asked the participants to report how they feel regarding learning with the text to be read (first assessment) and how they felt during learning with the text they read (second assessment). The items were adapted accordingly. For example, an item assessing hope before reading was "The thought of achieving my learning objectives inspires me," and after reading it was "The thought of achieving my learning objectives inspired me." An item assessing hopelessness before reading was "I wish I could quit because I can't cope with it" and after reading was "I wished I could quit because I couldn't cope with it." The

participants indicated their agreement with each item on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). We created a hope/hopelessness scale by averaging the scores on all 8 items before and after reading, respectively. Before combining the items into one scale, we reversed-coded the items for hope. Hence, values closer to 5 indicate greater hopelessness. We decided to combine the hope and hopelessness items into one scale because they can be regarded as measuring a similar construct. For instance, a low degree of hope equals a high degree of hopelessness. Accordingly, they rest at the opposite ends of the valence and activation dimensions: Hope is a positive activating emotion, while hopelessness is a negative deactivating emotion. Moreover, the hope/hopelessness scale provides a more parsimonious description of the learners' emotional state and facilitates the interpretation of the results. Internal consistency for the scale was good at the first ($\alpha = 0.86$) and the second ($\alpha = 0.87$) assessment.

To prevent participants from easily remembering the items and recognizing their purpose, we adapted four further items from the Intrinsic Motivation Short Scale (Wilde et al., 2009) and added them as filler items. For example, "Learning the text contents will be fun." These items were not considered for the analyses.

Comprehension

We assessed comprehension of the text with 10 questions in a multiple-choice format with four response options, one of which represented the correct answer. The questions required inferences and the application of the textual information. The participants received 1 point for each correct answer.

Metacomprehension Judgments

We assessed metacomprehension judgments in terms of predictions and postdictions. When making predictions, the participants estimated the number of comprehension questions they would presumably answer correctly before completing them. When making postdictions, the participants estimated the number of comprehension questions they presumably had answered correctly after completing them.

Metacomprehension Accuracy

We computed metacomprehension accuracy for predictions and postdictions and operationalized them in terms of bias. Bias reflects the magnitude and direction of the difference between a participant's judged and actual number of correctly answered comprehension questions. Positive values indicated overconfidence and negative values underconfidence.

Table 1. Descriptive statistics overall and by instruction-type group

Variable	Recue group		Control group		Overall sample	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Gender	81 % female, 19 % male		74 % female, 26 % male		77 % female, 23 % male	
Prior knowledge	0.13	0.34	0.13	0.34	0.13	0.34
Age	22.58	6.41	21.94	3.37	22.26	5.09
Number of semester	3.90	1.65	4.10	2.06	4.00	1.85
Hope/hopelessness	2.33	0.60	2.17	0.82	2.25	0.72
Text comprehension	.41	.18	.49	.22	.45	.20
Prediction magnitude	.55	.14	.55	.16	.55	.15
Postdiction magnitude	.41	.18	.36	.15	.38	.17
Prediction accuracy	.13	.21	.06	.21	.09	.21
Postdiction accuracy	-.01	.19	-.13	.24	-.07	.22

Procedure

First, the participants completed the prior knowledge test. Then, they received the emotion induction (i.e., hope, hopelessness, or neutral). Afterward, we assessed participants' emotional state. Next, they had 10 minutes to read the text about heat pumps. After they finished reading, we assessed their emotional state for the second time. The participants then received either the recue or the control instruction. Following that, the participants made their predictions. To do so, we informed them about the kind, format, and number of the subsequent comprehension questions. Thereafter, the participants answered the comprehension questions. There was no time limit for completing the questions. Finally, the participants made their postdictions and answered some demographic questions. At the end of the study, to lift participants' emotional state to a positive level, we applied an exercise from positive psychology. Specifically, we instructed the participants to associate a positive emotion with an object of their choice to evoke the emotion in themselves then and at any time. Before conducting the study, we applied pilot testing with a few students to check the comprehensibility of the materials and the appropriateness of the reading time.

Results

To facilitate the interpretation, we converted the dependent variables to percentages (prediction and postdiction accuracy are reported in percentage points, that is, the difference between the judgment in percent and performance in percent). We investigated whether the type of instruction (i.e., recue or control) moderates the effects of hope/hopelessness on the dependent variables by com-

puting regression-based moderation analyses. In each analysis, we entered hope/hopelessness, instruction type (originally coded with recue instruction = 0 and control instruction = 1), and their interaction term as predictors. We entered the variables in mean-centered form. We used the change in R^2 as the effect size index for the interaction effect. We used an alpha level of .05 for all analyses.

Preliminary Analyses

Table 1 presents the descriptive statistics. Because the distributions for age and number of semesters violated the normality assumption, we used nonparametric tests to analyze these control variables (i.e., Mann-Whitney U -test, Spearman correlation). As expected, participants' prior knowledge was generally low (see Table 1), with none of them receiving a total of 2 points. Moreover, the level of prior knowledge was the same in the recue and control group, $t(60) = 0.00$, $p = 1.000$, $d = 0.00$. Further, the two groups did not significantly differ regarding age, $U = 450.00$, $p = .664$, $r = .06$, number of semesters, $U = 481.50$, $p = .803$, $r = .03$, and gender, $\chi^2(1) = 0.37$, $p = .544$, $\phi = .08$. The groups were thus comparable regarding relevant learner characteristics. Concerning the associations of the control variables with the dependent variables, significant relations appeared only between gender and postdiction magnitude ($r = -.46$, $p < .001$; i.e., females provided lower postdictions) and between number of semesters and prediction accuracy ($r = .29$, $p = .024$). Running the respective moderation analyses with gender or number of semesters as covariates did not affect the results. We therefore report all moderation analyses without covariates.

Our goal with the emotion manipulation was to obtain a large range concerning participants' experienced hope/hopelessness. The scores on hope/hopelessness ranged from 1.00 to 3.38 on the first assessment and from 1.00 to 4.13 on the second assessment. Hence, there were also participants who experienced higher levels of hopelessness, especially during reading. This result indicates that our emotion manipulation fulfilled the intended purpose.

Moderation Analyses

In the model for comprehension, the interaction effect was nonsignificant (see Table 2). However, because the p -value was below .10, in an exploratory manner, we probed the interaction to unveil the pattern of the conditional effects. A simple slopes analysis showed that hope/hopelessness had a significant negative effect on comprehension in the control group, with an increase of one point on the hope/hopelessness scale leading to a decrease of 13% in comprehension, $b = -.13$, $SE = .04$, $\beta = -.45$, $t(58) = -3.00$, $p = .004$. In contrast, there was no significant effect in the recue group, $b = -.01$, $SE = .06$, $\beta = -.02$, $t(58) = -0.11$, $p = .911$. Hence, concerning our comprehension research question, the results indicate that greater hopelessness did not result in poorer comprehension when participants received the recue instead of the control instruction.

Concerning the magnitude of predictions and postdictions, the interaction effects were not significant (see Table 2). Thus, not supporting our prediction and postdiction hypotheses, the recue instruction did not significantly reduce the association between hope/hopelessness and metacomprehension judgments. Yet, there were significant first-order effects of hope/hopelessness, which reflected that greater hopelessness was generally associated with lower predictions and postdictions, as also shown by the correlational analyses (see Table 3).

Regarding the accuracy of predictions and postdictions, the interaction effects were not significant (see Table 2). Contrary to our prediction- and postdiction-accuracy hypotheses, the instruction type did not significantly affect the association of hope/hopelessness with metacomprehension accuracy. Unexpectedly, a significant first-order effect of the instruction type on postdiction accuracy appeared. An exploratory t -test showed that the recue group ($M = -.01$, $SD = .19$) was more accurate (i.e., less underconfident) than the control group ($M = -.13$, $SD = .24$), $t(60) = 2.30$, $p = .025$, $d = 0.22$.

Discussion

This study examined to what extent the impact of learners' reading-related hope or hopelessness on their text comprehension as well as on the magnitude and accuracy of their metacomprehension judgments (i.e., predictions and postdictions) varies depending on whether they receive a recue or control instruction. The recue instruction explicitly indicated the limited validity of emotions as cues for judging one's comprehension and pointed toward more valid judgment bases.

Regarding the prediction and postdiction hypotheses, the results showed that the learners drew upon their experienced hope or hopelessness to judge their comprehension. Specifically, higher hopelessness was related to lower predictions and postdictions. This finding supports previous research that found that learners use their achievement emotions for making metacomprehension judgments (Prinz-Weiß et al., 2022). In previous research, however, the learners experienced only relatively low levels of negative emotions. In the present study, there was greater variance in learners' emotional experience, including individuals who felt higher hopelessness. Regarding the cue-utilization framework (Griffin et al., 2009; also Koriat, 1997), the finding shows that hope and hopelessness function as judgment cues. However, hope and hopelessness rather represent heuristic cues as they are sometimes not associated with actual comprehension or associated with it to a different degree (i.e., less or more strongly) than relied on by the learners for making their judgments (see also Prinz-Weiß et al., 2022; Zaccolletti et al., 2020). One reason why emotions are such tempting cues might be that they are quite salient to learners. This assumption is in line with the affect infusion model (specifically, the affect-as-information principle, Forgas, 1995; see, e.g., also Schwarz & Clore, 1983, 1988), which suggests that feelings can exert a direct influence on judgments by providing experiential and bodily information regarding how one feels about the object of judgment. Thus, stronger positive emotions result in more positive judgments, and stronger negative emotions result in more negative judgments. Consequently, when judging their text comprehension, learners experiencing stronger hope during reading tend to make higher judgments, whereas learners experiencing stronger hopelessness during reading tend to make lower judgments. To conclude, reading-related hope and hopelessness do not necessarily represent valid cues and learners should be prevented from relying on them to judge their comprehension. This was the goal of the recue instruction. However, the results showed that the effect of the emotional state on metacomprehension judgments did not differ depending on

Table 2. Moderation analyses

Predictor	<i>b</i>	95% <i>CI_B</i>		<i>SE_B</i>	<i>t</i> (58)	<i>p</i>	β	ΔR^2
		<i>LL</i>	<i>UL</i>					
Comprehension								
Constant	.45	.40	.49	.02	18.36	< .001		
Hope/hopelessness	-.07	-.13	< -.01	.03	-1.86	.068	-.24	
Instruction type	.07	-.02	.16	.05	1.37	.178	.17	
Hope/hopelessness x instruction type	-.12	-.25	.01	.07	-1.68	.098	-.21	.04
$R^2 = .17, F(3, 58) = 3.86, p = .014$								
Prediction magnitude								
Constant	.55	.51	.57	.02	36.59	< .001		
Hope/hopelessness	-.14	-.19	-.08	.03	-6.13	< .001	-.65	
Instruction type	-.02	-.09	.04	.03	-0.75	.458	-.08	
Hope/hopelessness x instruction type	-.01	-.13	.09	.06	-0.12	.908	-.01	< .01
$R^2 = .42, F(3, 58) = 13.97, p < .001$								
Postdiction magnitude								
Constant	.38	.34	.42	.02	19.23	< .001		
Hope/hopelessness	-.08	-.15	< -.01	.04	-2.77	.007	-.35	
Instruction type	-.06	-.14	.02	.04	-1.56	.124	-.19	
Hope/hopelessness x instruction type	-.04	-.20	.09	.07	-0.70	.486	-.09	.01
$R^2 = .17, F(3, 58) = 3.95, p = .012$								
Prediction accuracy								
Constant	.10	.04	.15	.03	3.68	.001		
Hope/hopelessness	-.07	-.15	.02	.04	-1.72	.090	-.23	
Instruction type	-.09	-.19	.01	.05	-1.66	.103	-.21	
Hope/hopelessness x instruction type	.12	-.06	.26	.08	1.46	.149	.19	.03
$R^2 = .10, F(3, 58) = 2.03, p = .120$								
Postdiction accuracy								
Constant	-.07	-.12	-.01	.03	-2.38	.021		
Hope/hopelessness	-.01	-.09	.08	.04	-0.35	.729	-.05	
Instruction type	-.13	-.23	-.02	.06	-2.30	.025	-.29	
Hope/hopelessness x instruction type	.08	-.12	.23	.09	0.97	.336	.13	.02
$R^2 = .10, F(3, 58) = 2.05, p = .118$								

Note. *CI_B* = bootstrapped confidence interval; *LL* = lower limit; *UL* = upper limit; *SE_B* = bootstrapped standard error. We used 5,000 bootstrap samples to generate standard errors and 95% confidence intervals.

whether the learners received the recue or control instruction. A potential reason might be that, although such a parsimonious intervention would have been favorable for implementation in instruction, it was too scarce to affect learners' judgment processes. Reattribution techniques in educational settings sometimes require learners to reflect on the presented reattribution information to strengthen it through elaborative processing and consolidation. For example, this can occur through group discussions in which students discuss attributions they made, writing assignments that require students to summarize

and apply the reattribution information, and tests that enable students to practice ascribing favorable attributions to successes and failures (e.g., Hall et al., 2004; Struthers & Perry, 1996; see also Perry et al., 2014). These methods could be transferred to the context of metacomprehension judgments. Specifically, one could design a more comprehensive intervention in which, once learners have been informed about cues and their validity, they engage in group discussions or write reflections about cues they have used and how they might have affected their judgments. Besides, learners could take several tests

Table 3. Correlations for the main study variables

Variable	1.	2.	3.	4.	5.	6.	7.
1. Prior knowledge	-						
2. Hope/hopelessness	-.13	-					
3. Text comprehension	.12	-.32*	-				
4. Prediction magnitude	.01	-.64**	.29*	-			
5. Postdiction magnitude	.16	-.36*	.28*	.48**	-		
6. Prediction accuracy	-.10	-.15	-.75**	.42**	.07	-	
7. Postdiction accuracy	.01	.03	-.70**	.09	.49**	.73**	-

Note. * $p < .05$. ** $p < .001$.

and provide judgments to practice using valid cues rather than relying on their emotional states. In fact, a previous study conducted within a university lecture indicated that training in which, in addition to receiving information about the dangers of overconfidence, students take practice exams and provide judgments on which they obtain feedback, can enhance their judgment accuracy and performance (e.g., Händel et al., 2020). Another potential reason could be that, although the recue instruction hinted toward more valid cues (i.e., understanding of central text messages), the learners did not know how to derive these cues (especially for their predictions) and thus still used their experienced hope or hopelessness. Interventions such as delayed summary writing or diagram completion have proven useful in providing learners with more valid cues (e.g., Prinz et al., 2020b). Hence, the recue instruction might be combined with these interventions to yield larger effects and enhance learners' cues use.

Concerning the comprehension research question, although the interaction effect on comprehension failed to reach significance and was rather small, exploratory analyses indicated that the impact of the emotional state differed depending on the instruction type. When learners received the control instruction, greater hopelessness significantly impaired comprehension, whereas this was not the case when learners received the recue instruction. Apparently, the recue instruction affected cognitive rather than metacognitive processes. Potentially, particularly for learners who experienced greater hopelessness, the information that emotions are not necessarily valid indicators of one's comprehension might have increased their attention when answering the comprehension questions and thus counteracted potential negative effects of the emotional state on comprehension. Specifically, the learners might have been more focused and invested greater effort when completing the questions as they devoted less cognitive resources to processing their emotional state. Self-reports of invested mental effort or dual-task tech-

niques in which two tasks must be performed simultaneously to observe performance drops that are indicative of decrements in mental effort could be applied to shed light on the suggested mechanisms. As indicated previously, although greater hopelessness was associated with poorer comprehension for learners who received the control instruction, this does not mean that the emotional state is a valid cue. More precisely, even if their experienced hope or hopelessness might be indicative of their comprehension level (i.e., higher hope indicates better and higher hopelessness poorer comprehension), the learners might over- or underrate the extent to which this is the case, producing inaccurate judgments (see also Prinz-Weiß et al., 2022).

Regarding the prediction- and postdiction-accuracy hypotheses, the results revealed that the instruction type did not moderate the effect of the emotional state on the accuracy of learners' predictions and postdictions. However, concerning postdiction accuracy, learners who received the recue instruction were more accurate (i.e., less underconfident) than learners who received the control instruction. In line with the cue-utilization framework and its assumptions about postdictions (Griffin et al., 2009), after having completed the comprehension questions, the learners may have generally had access to additional, more valid cues, such as the fluency with which they answered the questions or the perceived difficulty of the questions. Because, in contrast to learners who received the control instruction, learners who received the recue instruction were made aware that such cues might be more valid as they are indicative of one's understanding of the central text messages, they might have used these cues to a larger extent and hence provided more accurate postdictions.

Limitations and Future Research

In this study, we focused on the emotional state of hope or hopelessness. However, learners can experience many more achievement emotions, such as anxiety or enjoyment, when reading a text, which might be used as cues and are therefore worth investigating (Prinz-Weiß et al., 2022). Nonetheless, previous research showed that hope and hopelessness frequently occur in learning contexts (e.g., Pekrun et al., 2002, 2011) and are comparatively strongly relied on as judgment cues (Prinz-Weiß et al., 2022). Moreover, we used an emotion manipulation to induce greater variance in the experience of hope or hopelessness, which would have been difficult to implement for various emotions.

When inducing hope and hopelessness, we did not aim at varying learners' perceived value of studying the material, because inducing a low value in the hopelessness condition could have evoked other emotions. For example, when learners believe that they have little influence on their success in mastering the material (i.e., low control) and also do not see why they should study it (i.e., low value), they might rather perceive boredom than hopelessness. In fact, hopelessness arises when performance is of subjective importance (e.g., Pekrun, 2006; Shao et al., 2020). In addition, varying several appraisal dimensions within the emotion induction would have blurred the effects. Specifically, it would have been unclear to which appraisal variation – control and/or value – the effect of the emotion induction should be attributed. Therefore, we focused on the control appraisal to induce hope and hopelessness. As valid experimental manipulations of emotions seem rare and difficult to implement, future research might explore further induction approaches and vary both appraisal dimensions.

We did not assess other cues in addition to the emotional state, which would be helpful in unveiling the extent to which a recue instruction not only reduces the reliance on emotions but also increases the use of more valid cues. Future studies could, for example, use self-reports or the think-aloud methodology during reading and judgment-making to assess learners' cue use.

Some learner characteristics such as trait emotions, working-memory capacity, self-concept, and academic achievement might play a role in the effectiveness of the emotion induction as well as in the impact of the emotional state on text comprehension and metacomprehension. For example, learners who are more confident in their reading ability or their content-related knowledge might be more susceptible to the induction of hope (and less to the induction of hopelessness). In addition, compared to learners with lower self-concepts, for these learners the effects of their hope might be more pro-

nounced. Future research should therefore examine how such stable learner characteristics relate to the achievement emotions the learners experience during reading and to their subsequent comprehension and metacomprehension.

We measured metacomprehension accuracy in terms of bias, which reveals over- and underconfidence. Relative accuracy is another measure of metacomprehension accuracy, which refers to the correlation between a learner's metacomprehension judgments and actual comprehension performance across several texts. It provides information about how accurately a learner can differentiate between better and worse comprehended texts (e.g., Schraw, 2009). Therefore, further research might apply multiple texts and examine relative accuracy to provide further information concerning the impact of achievement emotions on learners' metacomprehension accuracy. Moreover, previous research showed that the question format can affect metacomprehension accuracy (Prinz et al., 2020a). In the present study, the participants had to complete and provide judgments concerning multiple-choice questions. Future studies might investigate how much the findings extend to other question formats, such as short-answer questions or free recall.

Finally, we examined university students without an emotional strain or psychological disease. It is unclear to what extent the findings are generalizable to other samples, such as younger students or individuals with clinically relevant levels of hopelessness.

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