Does feedback targeting text comprehension triggers the use of reading strategies or changes in readers' attitudes? A meta-analysis

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Background: Previous meta-analyses have shown that feedback targeting text comprehension given when students perform a reading task positively influences learning from text. So far, differences in the effects of feedback were explained by design features, such as the timing and richness of feedback. In the present study, we aim to investigate cognitive and affective processes that might be triggered by feedback targeting text comprehension.

Method: Two meta-analyses were performed on feedback intervention studies that included statistics for both the effect of feedback targeting text comprehension on the use of reading strategies ($k = 8$) or readers' attitudes towards the reading task ($k = 10$) and the effect of feedback on reading comprehension. We first tested whether feedback significantly affected the use of reading strategies or readers' attitudes. We then performed a meta-regression analysis to test if the magnitude of the effect significantly predicted gains in reading comprehension.

Results: Feedback targeting text comprehension had a positive and significant impact on the use of reading strategies ($g^+ = 0.61$) and on reading comprehension ($g^+ = 0.34$). Additionally, the magnitude of the effect on the use of reading strategies was positively related to the magnitude of the effect on reading comprehension. Feedback targeting text comprehension did not influence readers' attitudes towards the reading task. Also, no significant effect of feedback was found for reading comprehension in these studies.

Conclusions: Feedback targeting text comprehension helps students to apply reading strategies more often and/or more efficiently, even when they read new texts without the help of feedback. This transfer of practiced reading strategies in turn fosters reading comprehension. Due to the scarce number of studies, the results of the present

meta-analysis should be interpreted as an incentive for the field of reading research to unify empirical approaches for the integrated study of affective processes triggered by feedback targeting text comprehension.

Keywords: feedback, reading comprehension, attitude, reading strategies, meta-analysis

Highlights

What is already known about this topic

- Feedback that targets text comprehension has, on average, been shown to positively influence reading comprehension. However, study heterogeneity is high.
- Different design features of feedback, such as the richness and timing of the feedback, only partially explain the variance in effects.

What this paper adds

- Feedback targeting text comprehension has a positive effect on the use of reading strategies, even when reading new texts without the help of feedback.
- The strength of this effect in turn predicts gains in reading comprehension.
- The currently available studies show no effect of feedback targeting text comprehension on readers' attitudes towards the reading task; however, studies on this topic are scarce and divergent, making this conclusion tentative.

Implications for theory, policy or practice

- Feedback during reading that targets text comprehension can be used as an effective instructional tool to enhance the use of reading strategies and, consequently, to improve reading comprehension.
- Future research on how to effectively use feedback in reading instruction should distinguish two different perspectives: feedback as a tool to facilitate text comprehension 'on the job' and feedback as a tool to teach reading strategies that facilitate text comprehension.
- The current meta-analysis shows that the effects of feedback that targets text comprehension on reading attitude or reading motivation are understudied. Secondly, operationalisations of attitudinal and motivational variables in the scarce studies on this topic diverge, hindering interpretation of the available results. Strong research programmes that unify empirical approaches for studying the effects of feedback targeting text comprehension on readers' attitudes and other motivational factors are needed.

Difficulties in reading comprehension skills are a common obstacle for learning among students in all levels of education (see e.g., Cecilia, Vittorini, Cofini, & di Orio, 2014; Gorzycki, Howard, Allen, Desa, & Rosegard, 2016; OECD, 2019). The inability to create

a complete and coherent mental model of the text hinders students' abilities to sufficiently understand and thereby learn from a text (see e.g., Kintsch, 1986; Van den Broek, Virtue, Everson, Tzeng, & Sung, 2002). To address this issue, the development of a thorough understanding of both reading comprehension and its underlying skills, as well as the effects of instructional strategies on comprehension, is crucial (see Israel & Reutzel, 2017). One of the vital elements of effective instruction in reading comprehension is providing students with feedback targeting text comprehension (Crossley & McNamara, 2017). In line with previous review studies (see e.g., Azevedo & Bernard, 1995; Hattie, 2012; Kluger & DeNisi, 1996; Kulhavy, 1977; Shute, 2008; Swart, Nielen, & Sikkema-de Jong, 2019), we define feedback as individualised information in response to readers' answers to comprehension questions about the text they read. The information in a feedback message can range from a simple right/wrong statement to providing the correct answer accompanied with explanatory information or instruction (e.g., Lasoff, 1981, 'Yes you're right. The index variable cannot be two letters. A letter and a number would be fine, but we are not allowed to call an index "counter" with a two-letter name.'; Lee, Lim, & Grabowski, 2010, 'Incorrect! Now would be a good time to ask yourself if you have learned all the important information. If you haven't, it would be a good idea to return to the previous page to revise your highlighting or note.').

A previous meta-analysis covering decades of research showed on average a positive effect of feedback on reading comprehension but also showed that effects differed with respect to two design features: the timing of feedback and the richness of information provided in feedback messages (Swart et al., 2019). With regard to timing, feedback was found to be less effective if it was provided during reading than after reading because feedback during reading required the reader to multitask by processing the text and the content of the feedback, and by integrating the two processes. This additional load on the reader's working memory hindered the reading process (Sweller, 1994; Sweller, van Merrienboer, & Paas, 1998). With regard to the richness of the information provided in the feedback message, feedback containing the correct answer or both the correct answer and explanations was more effective than feedback solely stating 'right' or 'wrong'. This only held, however, when feedback was provided after reading the text rather than during reading.

Insight into the effects of different design features of feedback is important to gain a thorough understanding of the effectiveness of feedback as an instructional tool. Nevertheless, it is similarly important to investigate *how* feedback fosters reading comprehension. In the present meta-analysis, we therefore aim to provide more insight into the cognitive and affective processes that are triggered by feedback on reading comprehension. This aim is in line with the *Feedback Intervention Theory* (FIT; Kluger & DeNisi, 1996), stating that it is crucial to understand students' total reaction to feedback, not only the targeted learning outcome.

From a Vygotskian perspective, feedback can be seen as a form of scaffolding aimed at reducing the gap between actual and desired performance (Bransford, Brown, & Cocking, 2000; Shute, 2008). In the case of reading comprehension, this is the gap between a reader's current understanding of the text and a complete and coherent mental model of the text. As such, feedback has a cognitive function, namely to inform the reader about misunderstandings, to fill in gaps in understanding and/or to increase awareness of one's level of understanding (Ilies, Judge, & Wagner, 2010). Creating awareness of one's level of understanding is essential when teaching students to self-regulate their learning from texts (see Hoska, 1993; ter Beek, Brummer, Donker, & Opdenakker, 2018). Self-regulated learning requires both (meta)cognitive strategies such as inference making

and comprehension monitoring, and affective processes such as the will to learn. In a recent review on scaffolding in computer-assisted learning, ter Beek et al. (2018) argued that effective feedback should help students to pay attention to both the cognitive and affective components of self-regulated learning. Likewise, Kluger and DeNisi (1996) in their FIT stated that the effects of feedback on learning performance could be explained by the combination of cognitive and affective processes. Accordingly, in the present meta-analysis, we investigate the effects of feedback targeting text comprehension on these two types of processes. First, we investigate if feedback targeting text comprehension triggers the use of reading strategies. Second, we investigate if feedback targeting text comprehension triggers changes in readers' attitudes towards the reading task.

Feedback targeting text comprehension as a trigger to use reading strategies

Effectively applying reading strategies while reading is essential for reading comprehension (see Gersten, Fuchs, Williams, & Baker, 2001; Graesser, 2007; Palinscar & Brown, 1984). In line with Graesser (2007), we define reading strategies as the cognitive actions (e.g., connecting information from the text to background knowledge) or behavioural actions (e.g., highlighting) during reading aimed at constructing a coherent mental model of the text. Examples of strategies shown to be essential for reading comprehension are comprehension monitoring, questioning, rereading passages, making inferences during reading and using background knowledge. Results of intervention studies have shown positive effects of feedback targeting text comprehension on comprehension monitoring, self-questioning, highlighting and strategic decision-making when searching for relevant information in a text (e.g., Llorens, Cerdán, & Vidal-Abarca, 2014; Llorens, Vidal-Abarca, & Cerdán, 2016; Sung, Chang, & Huang, 2008). Additionally, Bransford et al. (2000) argue that feedback can help students to develop comprehension monitoring skills, which can then be applied at a later stage in situations in which students do not receive feedback.

Acknowledging the importance of effectively deploying reading strategies for reading comprehension, several researchers have stressed the relevance of instruction in reading strategies in readers both with and without reading difficulties (see e.g., Crossley & McNamara, 2017; Gersten et al., 2001; Okkinga et al., 2018). However, a question that needs to be answered first is whether instruction results in strategy transfer to situations in which students have to read new texts independently. This transfer aspect is understudied in research on the effects of reading strategy instruction in general (Elleman & Compton, 2017), as well as in the specific case of feedback targeting text comprehension (Swart et al., 2019).

Feedback targeting text comprehension as a trigger for changes in readers' attitudes towards the reading task

Next to the cognitive effects, we also investigate affective effects of feedback targeting text comprehension, specifically focussing on readers' attitudes. Conradi, Jang, and McKenna (2014) described readers' attitudes, comprising of readers' feelings and thoughts that relate to a reading task, as one of the major factors underlying reading motivation. A more positive attitude towards a reading task motivates readers to invest cognitive effort in understanding the materials they are reading, which positively influences reading comprehension (Guthrie & Wigfield, 2000; Guthrie, Wigfield, & You, 2012). This willingness to

invest cognitive effort in understanding the text is especially important in educational contexts where students are required to learn from texts that are complex and of high information density (van den Broek et al., 2001; Wolters et al., 2017).

In the present meta-analysis, we asked whether feedback targeting text comprehension triggered readers to perceive the reading task more positively (e.g., more useful, educational, enjoyable or within their reach). Kluger and DeNisi (1996) in their FIT describe that feedback should motivate students to increase cognitive effort in order to improve their understanding of the text they are reading. Hattie and Timperley (2007) argued that providing readers with information about their current understanding of a text increases expectancies for success and self-efficacy and, at the same time, reduces feelings of uncertainty (see also Kulhavy & Wager, 1993; Shute, 2008; ter Beek et al., 2018; Wigfield, Gladstone, & Turci, 2016). In other words, feedback targeting text comprehension can be understood as an incentive to establish a positive attitude towards the reading task by reinforcing feelings of autonomy and competence (Ryan & Deci, 2000). According to the FIT (Kluger & DeNisi, 1996), feelings of competence can only be achieved if (1) students believe that they are able to close the gap between their current level of understanding and the required level of understanding and (2) the feedback is perceived as being helpful in achieving this required level of understanding the text. If these two conditions are not met, feedback targeting text comprehension may also negatively influence readers' attitudes towards the reading task. Consequently, this might reduce the cognitive effort that readers are willing to put in the reading task (Kluger & DeNisi, 1996).

Results presented in studies on feedback targeting text comprehension that include measures of both readers' attitudes and reading comprehension are ambiguous. Martin, Klein, and Sullivan (2007) for instance found that feedback on the readers' responses to comprehension questions resulted in a more positive attitude towards the reading task, an increased belief in the usefulness of the reading task and increased reading comprehension, compared with a control condition in which students did not receive feedback. Other research, however, has shown that feedback on the readers' responses to comprehension questions did not influence readers' attitudes towards the reading task either positively or negatively, but did influence reading comprehension negatively (see e.g., Lasoff, 1981; Saunders, 1998). Jacobs and Kulkarni (1963) found that students from one junior high school rated a reading task less interesting when they received feedback on their answers to comprehension questions, whereas students from another high school rated the reading tasks with and without feedback equally interesting. Nevertheless, feedback had a negative effect on reading comprehension in both groups, as measured by a combination of multiple-choice and open comprehension questions about the text that was read.

Present study

The aim of the present study is first to investigate whether feedback targeting text comprehension triggers (1) the use of reading strategies and (2) changes in readers' attitudes towards the reading task (from now on referred to as 'readers' attitudes') when compared with reading tasks without feedback. Second, we investigate whether gains in reading comprehension are greater when the feedback has a larger impact on the use of reading strategies or readers' attitudes.

In line with the scarce number of previous studies on the effects of feedback on reading strategy use and reading comprehension (e.g., Bransford et al., 2000; Lee et al., 2010;

Llorens et al., 2014, 2016), we expect feedback targeting text comprehension to have a positive impact on the use of reading strategies. In the case of readers' attitudes, both a positive or negative effect of feedback targeting text comprehension could be expected. Based on theories stating that feedback could provide the reader with feelings of autonomy and competence (Locke & Latham, 1990) and the idea that feedback may reduce feelings of uncertainty (Ryan & Deci, 2000; Shute, 2008; Wigfield et al., 2016), a positive effect of feedback targeting text comprehension on readers' attitudes could be expected (see also ter Beek et al., 2018). Alternatively, this type of feedback could have a negative effect on attitude if it does not support readers' beliefs in their ability to gain a thorough understanding of the text, or in the usefulness of the feedback itself as a tool to achieve this (see Kluger & DeNisi, 1996). Both hypotheses are based on the belief that feedback will *engage* the reader to select among different courses of action as opposed to the view that the learner is a passive recipient of the feedback (Black & Wiliam, 1998).

Subsequently, in the case that feedback targeting text comprehension appears to have a significant effect on the use of reading strategies and/or readers' attitudes, we then investigate whether the magnitude of the effects moderate the gains in reading comprehension found in these studies. Because of the importance of the use of reading strategies for reading comprehension (see e.g., Gersten et al., 2001; Graesser, 2007; Palinscar & Brown, 1984), and the relationship between readers' attitudes on the one hand and reading comprehension on the other hand (see e.g., Guthrie et al., 2012; Guthrie & Wigfield, 2000; Wolters et al., 2017), we propose that the magnitude of the effects of feedback targeting text comprehension on the use of reading strategies and/or readers' attitudes could, at least partially, explain the effects of this type of feedback on reading comprehension.

Methods

Inclusion criteria

The present meta-analysis is performed on studies that tested the effects of feedback on readers' responses to questions/tasks targeting text comprehension during or directly after reading text. Studies were included if statistics were present for at least one outcome measure for the use of reading strategies when reading a new text in a reading post-test or for readers' attitudes. Additionally, reports had to meet the following criteria: (1) an intervention study was described that compared a feedback targeting text comprehension condition with a control condition in which participants read similar or comparable texts (i.e., not lists of words or an unconnected set of sentences) but received no feedback, (2) participants were conventional readers who independently read informative or narrative texts, and (3) reports were written in English. No restrictions were set for students' age or country of origin or publication status.

Measures for the use of reading strategies included in the meta-analysis were self-reports on the use of reading strategies (e.g., Lee et al., 2010), tasks that tested the use of a specific reading strategy (e.g., use-of-strategy test, Sung et al., 2008) or behavioural data that were collected during the reading task (e.g., rereading previous pages of text, see Llorens et al., 2014; or highlighting, see Lee et al., 2010). To investigate the effect of feedback on readers' attitudes, all measures that contained information about the readers' feelings and thoughts that related to the reading task (see Conradi et al., 2014) were included in

the present meta-analysis.[1] Examples of feelings and thoughts were the degree of liking or disliking the task, enjoyment and perceived usefulness of the learning task.

Information sources

A literature search was performed of more than 15,000 references to journal articles, research reports, conference proceedings, dissertations, handbooks and book chapters published up to March 2020 in seven databases (PsycInfo, PsycArticles, ERIC, Proquest Dissertations and Theses Global, Web of Science, Linguistic and Language Behavior Abstracts and Google Scholar; see Figure 1 for an overview of the literature search). Search queries were combinations of the terms books, e-books, literacy, and reading with the terms feedback, scaffolding, interactivity and tutoring (see Swart et al., 2019, Appendix A, for a complete overview of the search terms). Additionally, references of review studies, relevant handbooks and eligible studies that we found in the online databases and publication lists of authors of reports that were included in the meta-analysis were checked. The literature search resulted in 11 study reports, including 18 contrasts.

Coding procedures

Bibliographical information, sample characteristics and outcome measures for reading comprehension, the use of reading strategies when reading new texts, and readers' attitudes, were coded for each study report and contrast by the first author and two trained undergraduate students (for details, see Swart et al., 2019). The students coded all reports in pairs and had to reach consensus on each coding category. Inter-coder reliability between the coding of the students and the first author was on average $\kappa = .92$ ($SD = 0.10$; range 0.77–1.00). In case of disagreements, the first author made a final coding decision.

Meta-analytic procedures

Hedges' g was calculated for the difference in mean scores between the feedback condition and the control condition. Raw means and standard deviations were used to calculate the effect sizes. A positive effect size indicated that participants applied more reading strategies when reading a new text after the feedback condition than the control condition or had a more positive attitude or performed better on reading comprehension post-tests after the feedback condition than the control condition.

Effect sizes for all outcome measures were entered into the Comprehensive Meta-Analysis software, Version 2.0 (Borenstein, Hedges, Higgins, & Rothstein, 2005) and inspected for outliers (standardised residuals larger than ±3.29; Tabachnick & Fidell, 2007). In the case of multiple measures for the same outcome within a contrast, effect sizes were averaged to account for dependency among the effect sizes. Subsequently, effect sizes were combined using the random effects model in order to take into account differences in reading tasks, samples and measurement instruments among the studies (Borenstein, Hedges, Higgins, & Rothstein, 2009; Lipsey & Wilson, 2001; Shadish & Haddock, 2009; Viechtbauer, 2007), weighing effect sizes by their inverse variance. For each combined effect, the 95% confidence interval was calculated, and heterogeneity was estimated based on the Q statistic (Lipsey & Wilson, 2001).
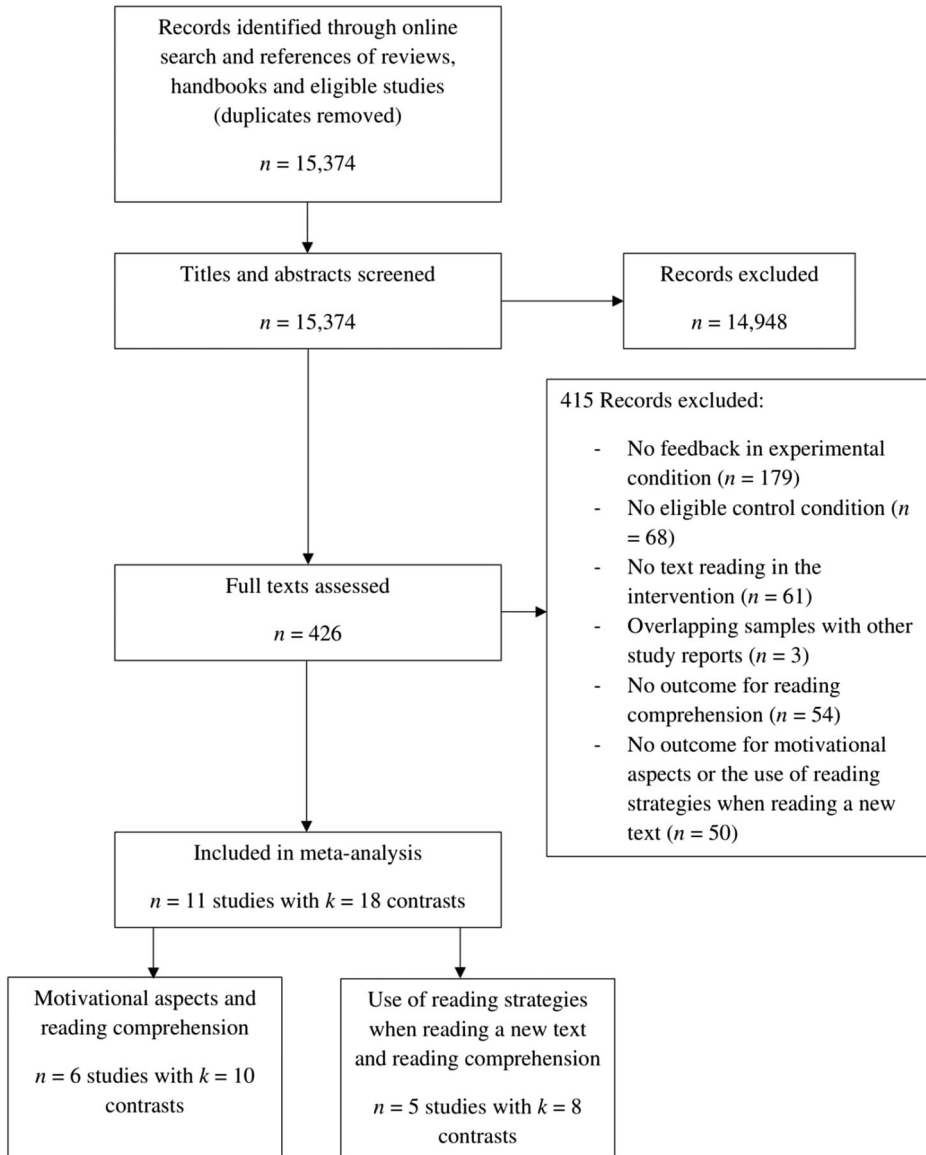
Figure 1. Flow diagram of the literature search process.

To check for publication bias, we graphically inspected funnel plots including all average effect sizes per contrast for the use of reading strategies or readers' attitudes. In case of asymmetry, Duval and Tweedie's (2000) trim-and-fill procedure was used to correct for publication bias. Additionally, we checked the classic fail-safe *N*, applying Rosenthal's criterion (Rosenthal, 1979), stating that a minimum fail-safe *N* of $5k + 10$ (k = number of study contrasts) is required to consider a combined effect robust.

Because there were no studies in which measures for both the use of reading strategies and readers' attitudes were included, we decided to perform two separate meta-analyses. The first on studies in which measures for the use of reading strategies when reading a

new text and reading comprehension were included, and the second on studies in which measures for readers' attitudes and reading comprehension were included. Subsequently, in the case of a significant effect, we performed a meta-regression analysis to test if the magnitude of the effect sizes for the effects on the use of reading strategies or readers' attitudes predicted the magnitude of the effect sizes of the effect of feedback on reading comprehension.

Results

Descriptive statistics

The present meta-analyses consisted of 8 contrasts that included statistics for the effects of feedback targeting text comprehension on reading strategy use when reading a new text and reading comprehension (see Table 1), and 10 contrasts that included statistics for one or more effects of feedback on motivational aspects and reading comprehension (see Table 2). Inspection of all effect sizes showed no outliers.

Feedback targeting text comprehension as a trigger to use reading strategies

Among the eight studies in which effects were reported on both the use of reading strategies when reading a new text and reading comprehension, feedback had a moderate positive effect on the use of reading strategies ($g^+ = 0.61$, $k = 8$, $SE = 0.22$, 95% CI = [0.17, 1.04], $p < .01$). Participants used more reading strategies after reading tasks including feedback targeting text comprehension than after control tasks without feedback. This effect was heterogeneous, $Q(7) = 42.74$, $p < .001$. The funnel plot for these studies showed a symmetrical pattern of effects sizes, and no effects had to be imputed. Additionally, the classic fail-safe N indicated that 91 contrasts with a null-effect were needed to turn the significant effect of feedback on reading strategies into a nonsignificant one. Based on these statistics, we concluded that the combined effect of feedback on the use of reading strategies was reliable and robust. Also, a significant positive effect of feedback on reading comprehension was found in these eight studies ($g^+ = 0.34$, $SE = 0.09$, 95% CI = [0.17, 0.50], $p < .001$). This effect was homogeneous ($Q(7) = 6.36$, $p = .50$).

A meta-regression analysis showed that the magnitude of the effects of feedback targeting text comprehension on the use of reading strategies positively predicted the effect of feedback on reading comprehension (coefficient = 0.29, $SE = 0.14$, 95% CI = [0.01, 0.56], $z = 2.04$, $Q = 4.14$, $p = .04$; see Figure 2). That is, in studies in which larger effects of feedback on the use of reading strategies were found, larger effects on reading comprehension also were found.

Feedback targeting text comprehension as a trigger for changes in readers' attitudes

Feedback targeting text comprehension had no significant effect on readers' attitudes ($g^+ = 0.07$, $k = 10$, $SE = 0.26$, 95% CI = [−0.44, 0.58], $p = .78$). On average, participants did not have a more positive or negative attitude towards the reading task if they received feedback targeting text comprehension. Also, the average effect of this type of feedback on reading comprehension in these 10 studies was nonsignificant ($g^+ = −0.02$; $SE = 0.21$, 95% CI = [−0.42, 0.38], $p = .93$).

Table 1. Overview of studies included in the meta-analysis on the effects of feedback targeting text comprehension on the use of reading strategies

First author	Year	N feedback	N control	Age group	Type of feedback[a]	Timing of feedback[a]	Effect on strategy use (Hedges' g)	Effect on reading comprehension (Hedges' g)
Lee	2010	74	74	Students	KOR	During	1.56	0.54
Llorens	2014A	30	14	Secondary	EF	During	0.80	0.67
Llorens	2014B	34	14	Secondary	KCR	During	0.28	0.35
Llorens	2016A, Exp. 1	51	25	Secondary	EF	During	−0.17	0.10
Llorens	2016B, Exp. 1	41	25	Secondary	EF	During	0.37	0.16
Llorens	2016C, Exp. 2	38	37	Secondary	EF	During	0.10	0.05
Sung	2008A	31	35	Primary	EF	After	0.89	0.22
Sung	2008B	34	30	Primary	EF	After	0.97	0.54

Notes: Students = (university or college) students. Primary = primary school children. Secondary = secondary school children, Type of feedback: KOR = knowledge-of-response feedback (right/wrong statement), KCR = knowledge-of-correct-response feedback, EF = elaborate feedback (correct answer + explanation or extra information), Timing of feedback: During = during reading, After = directly after reading a text.
[a]Information derived from Swart et al., 2019.

Table 2. Overview of studies included in the meta-analysis on the effects of feedback targeting text comprehension on readers' attitudes

First author	Year	N feedback	N control	Age group	Type of feedback[a]	Timing of feedback[a]	Effect on attitude (Hedges' g)	Effect on reading Comprehension (Hedges' g)
Chen	2011A	19	19	Students	KOR	During	0.05	−0.20
Chen	2011B	20	20	Students	KOR	During	0.29	0.67
Jacobs	1966A	15	12	Secondary	KCR	During	−1.47	−0.91
Jacobs	1966B	19	9	Secondary	KCR	During	0.05	−0.39
Lasoff	1981	12	12	Students	EF	During	0.28	−0.32
Martin	2007	43	43	Students	KOR	During	1.53	1.11
Saunders	1998A	17	17	Students	KCR	After	−0.03	−0.14
Saunders	1998B	17	17	Students	KCR	After	0.01	−0.44
Wentling	1973A	39	19	Secondary	KOR	After	0.55	0.17
Wentling	1973B	39	20	Secondary	KOR	After	−0.54	−0.31

Note: For a list of abbreviations, see the *note* in Table 1.
[a]Information derived from Swart et al., 2019.
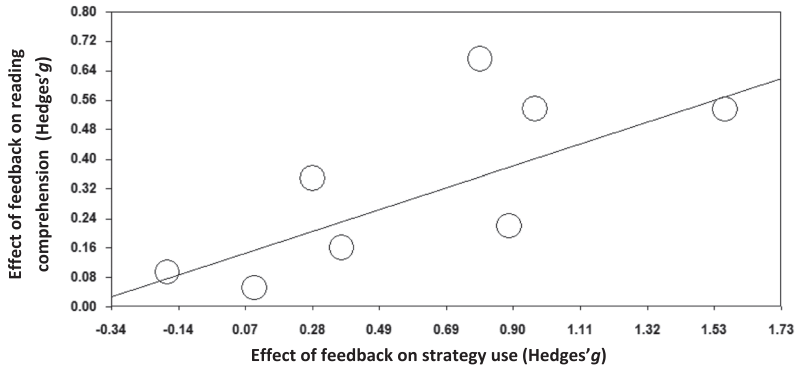
Figure 2. Results of meta-regression analysis ($k = 8$) of the magnitude of the effect of feedback targeting text comprehension on the use of reading strategies as predictor of the effect of feedback on reading comprehension.

Discussion

To date, research on the effects of feedback targeting text comprehension has mainly focused on design features (e.g., timing and richness) as an explanation for variance among the effects on reading comprehension (Swart et al., 2019). As a next step, and in line with the FIT (Kluger & DeNisi, 1996), the aim of the present study was to gain insight into the cognitive and affective processes that were triggered by the feedback. Particularly, we investigated the effects of feedback on the use of reading strategies and readers' attitudes. Results showed that feedback targeting text comprehension had a moderate positive effect on the use of reading strategies when reading a new text. The strength of the effect of the feedback on the use of reading strategies positively predicted the effect of feedback on reading comprehension. No effect of feedback targeting text comprehension was found on readers' attitudes. In these studies, the effect of feedback on reading comprehension was also not significant. This outcome should not be overinterpreted because the literature search resulted in a relatively small number of studies to be included in the meta-analysis. Also, attitude measures that were used varied between studies.

Feedback targeting text comprehension as a trigger to use reading strategies

The positive effect of feedback targeting text comprehension on the use of reading strategies when reading a new text is in line with our hypothesis based on previous research (e.g., Bransford et al., 2000; Lee et al., 2010; Llorens et al., 2014, 2016; Sung et al., 2008). The idea that feedback triggers students to shift attention to processes needed to accomplish understanding of the text (see Hoska, 1993) is also supported by these results. Readers applied (e.g., Llorens et al., 2016) and/or reported using (e.g., Lee et al., 2010) more reading strategies after reading tasks that included feedback targeting text comprehension than after reading tasks without this type of feedback. As was expected, based on the importance of adequately using reading strategies for reading comprehension (Gersten et al., 2001; Graesser, 2007; Palinscar & Brown, 1984), this positive effect of feedback on the use of reading strategies appeared to result in better reading comprehension as well. In other words, feedback targeting text comprehension helps students to apply reading strategies more often and/or more efficiently, and they can apply

these skills to new reading tasks for which they receive no feedback. Additionally, the ability to transfer the use of reading strategies to new texts where students do not have the help of feedback also fosters reading comprehension of these new texts. By empirically testing the results of feedback on both strategy use when reading a new text and reading comprehension, the results of the present meta-analyses contribute to an understudied area in the literature (see Elleman & Compton, 2017; Swart et al., 2019).

Although Swart et al. (2019) showed that feedback targeting text comprehension was most effective for supporting understanding of a text if provided directly after reading, in 75% of the contrasts in the present meta-analysis, feedback was provided during reading. Possibly, feedback during reading is less effective in supporting the understanding of the text that the student is currently reading but might be more effective in teaching reading strategies that students can use in new texts in which they do not receive feedback. Answers and explanations in feedback messages might function as a modelling approach for readers on how to effectively integrate information in the text into a coherent mental model, comparable with modelling approaches in reading comprehension instruction (see Afflerbach, Hurt, & Cho, 2020; Duke & Pearson, 2008).

The results of the present study should be interpreted with some caution. We were able to find only eight studies that met the inclusion criteria, specifically, that the effects of feedback targeting text comprehension was tested for both strategy use and reading comprehension. However, not only the number of studies should be considered but also the robustness of the effect (Valentine, Pigott, & Rothstein, 2010). The found effect of feedback on the use of reading strategies is robust as indicated by the fail-safe N, which indicated that 91 contrasts with a null-effect would be needed to turn the significant effect of feedback on reading strategies into a nonsignificant one (see also Fragkos, Tsagris, & Frangos, 2014). Yet, as a consequence of the limited number of studies, we were not able to investigate the interplay of design features of feedback targeting text comprehension (e.g., timing and richness) and the use of reading strategies. Additionally, although reading comprehension difficulties are common in all levels of education, future research should focus on how to best support and teach reading comprehension in groups of students of different age groups and skill levels.

Feedback targeting text comprehension as a trigger for changes in readers' attitudes

Theoretical perspectives on the affective effects of feedback targeting text comprehension pointed to both positive (Kluger & DeNisi, 1996; Locke & Latham, 1990; Ryan & Deci, 2000; Shute, 2008; Wigfield et al., 2016) and negative effects (Kluger & DeNisi, 1996). Results of the present meta-analysis showed that participants were on average neither more positive nor more negative towards the reading tasks when the tasks included feedback. The outcomes of this meta-analysis should be interpreted as a call to the field of reading researchers to develop research programmes that help unify empirical approaches to measure reading attitude. Based on the results of the available studies in our meta-analysis, we will give input for future studies.

Possibly, the lack of an effect of feedback targeting text comprehension on readers' attitudes in the present study is a consequence of the fact that we could not distinguish between good and poor performing students during the intervention. In line with Kluger and DeNisi's (1996) FIT, feelings of autonomy and competence might only increase when the gap between actual and desired performance can be bridged by the feedback

(see also Bransford et al., 2000; Shute, 2008). For poor performers, the gap might be too large, with the result that feedback mainly notifies them of errors and/or gaps in understanding. Additionally, research has shown that students particularly allocate attention to feedback on incorrect answers. Consequently, poor performing students spend more time on negative feedback than do good performing students (see Máñez, Vidal-Abarca, Kendeou, & Martínez, 2019). Increased attention to negative feedback has been shown to decrease motivation (Fong, Patall, Vasquez, & Stautberg, 2019). To clear up this ambiguity, we need experimental studies in which the effect of feedback targeting text comprehension (including different design features of this type of feedback) on reading comprehension and reading attitude will be compared between different subgroups of students (e.g., good and poor comprehenders).

Additionally, the questionnaires used in the primary studies targeted a wide range of attitudinal aspects with regard to the reading task ranging from interest (e.g., Jacobs & Kulkarni, 1963) to perceived usefulness (Chen, Teng, & Lee, 2011) and preferences for certain reading tasks (e.g., 'I would enjoy using other computer programs like this one in future lessons'; Martin et al., 2007). In future research, design features of feedback targeting text comprehension should be systematically tested in relation to these different aspects and how these affect different groups of students (e.g., good and poor comprehenders, see Máñez et al., 2019).

Limitations

All scientific studies suffer from limitations and so do our meta-analyses. An obvious one is the relatively low number of studies that we were able to include in both meta-analyses. As a result of the limited number of studies and the content of these studies, we were not able to investigate the interplay of design features of feedback targeting text comprehension (e.g., timing and richness) and the two different instructional perspectives (i.e., feedback to facilitate reading comprehension 'on the job' and feedback as an instructional tool to teach reading comprehension skills). However, a meta-analytic approach can be justified in cases of a limited number of studies. The meta-analytic procedure is characterised by a structured and transparent approach and is thus less vulnerable for type II errors compared with narrative reviews (Cooper & Rosenthal, 1980). Second, meta-analyses are less vulnerable to biases such as overestimation or underestimation of overall outcomes as a consequence of study characteristics that might easily attract attention, such as salient titles or large positive or negative results (Bushman & Wells, 2001). To conclude, a meta-analysis is in many cases the better choice than narrative reviews to synthesise the literature because of its analytical and replicable procedures (Valentine et al., 2010).

Conclusions

In the present meta-analysis, we aimed to gain more insight into the effects of feedback by testing whether feedback targeting text comprehension triggers (1) the use of reading strategies and (2) changes in readers' attitudes towards the reading tasks. The present meta-analysis shows that research on the effects of feedback has mainly focused on learning outcomes for reading comprehension, with less attention given to other cognitive and affective processes related to reading comprehension. Studies focused on the cognitive and affective processes triggered by feedback targeting text comprehension are scarce.

The eight studies that did focus on reading strategies showed that feedback targeting text comprehension positively influenced readers' abilities to deploy reading strategies even in situations in which they did not receive feedback. This transfer of reading strategy skills consequently related to improved reading comprehension.

The ten studies that included information on the effects of feedback targeting text comprehension on both readers' attitudes and reading comprehension showed that feedback did not influence readers' attitudes in a positive or negative way. Also, no effect of feedback on reading comprehension was found in these studies. As argued before, this result should not be overinterpreted.

The present meta-analysis extends prior research on the effects of feedback targeting text comprehension and should at the same time be interpreted as an inducement for researchers to systematically study the possible correlates of feedback targeting text comprehension. Additionally, future research should integrate different design features of feedback, the cognitive and affective processes triggered by the feedback, and the targeted learning outcomes in different groups of readers. We showed that the field is especially in need of a strong research programme that unifies empirical approaches for studying reading attitude and its relation to the effects of feedback targeting text comprehension.

Note

1. Although initial search procedures focussed on the broad concept of reading motivation, careful consideration of the measures in the articles that came up in the search procedures, resulted in the conclusion that the eligible studies specifically focussed on readers' attitudes towards the present reading task. No measures of transfer of readers' attitudes towards other reading tasks or reading in general were found.

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