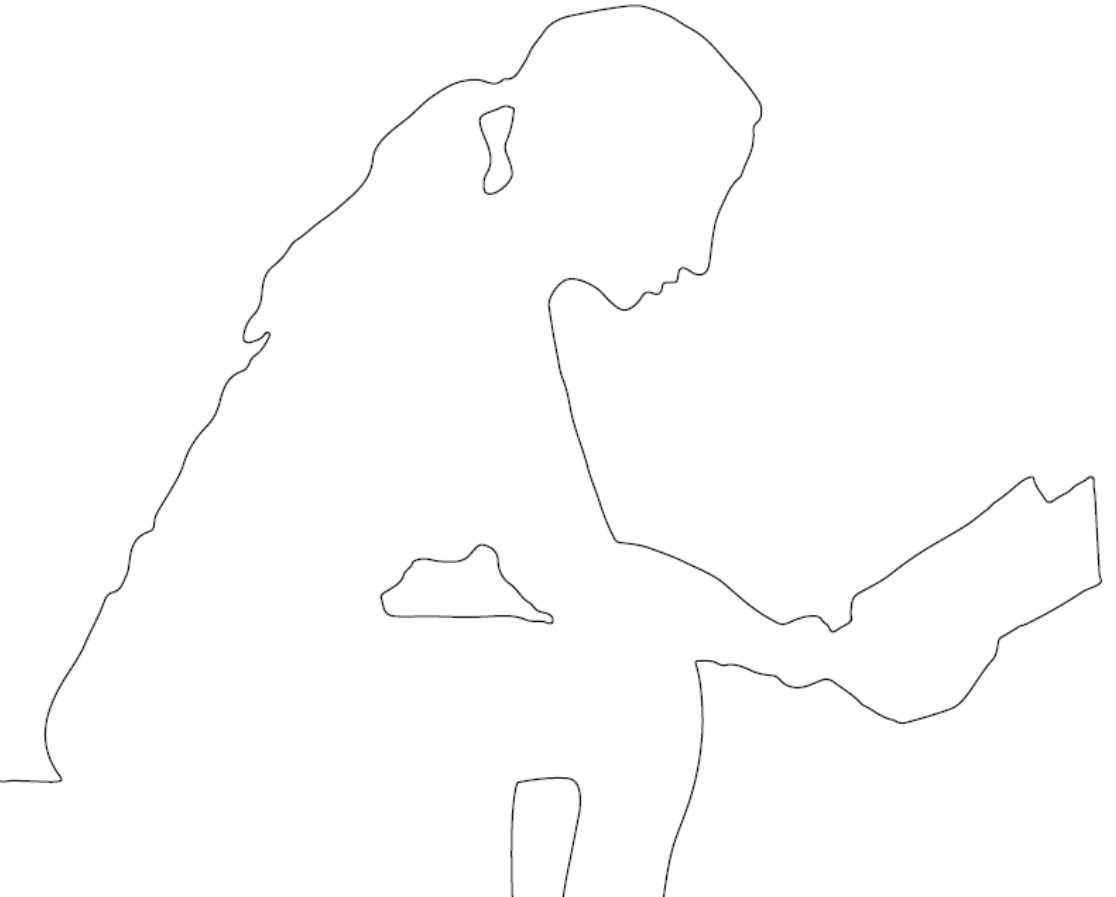
Mind the reading mind: a multifaceted and methodologically diverse approach to investigating the role of attentional control and feedback in reading comprehension

Swart, E.K.



Chapter 5

Explaining the Effect of Feedback on Reading Comprehension: A Meta-Analysis on the Effects of Feedback on the Use of Reading Strategies and Motivational Aspects

Based on:

Swart, E. K., Nielen, T. M. J., & Sikkema-de Jong, T. M. (under review). Explaining the effect of feedback on reading comprehension: A meta-analysis on the effects of feedback on the use of reading strategies and motivational aspects.

Abstract

Background: Previous meta-analytic research has shown that feedback given when students perform a reading task positively influences learning from text but that the effects are moderated by the timing and the richness of feedback. An unanswered question, however, is whether the positive effects of feedback could be explained by its influence on the capability to use reading strategies or on motivational aspects. In the present meta-analysis we aim to answer this question.

Method: Two meta-analyses were performed on feedback intervention studies that included statistics for both the effect of feedback on the use of reading strategies *(k* =8) or motivational aspects *(k* = 10) and the effect of feedback on reading comprehension. In case of a significant effect of feedback on the use of reading strategies or motivational aspects, a meta-regression analysis was performed to test if the magnitude of these effects moderated the effect of feedback on reading comprehension.

Results: Results showed that feedback had a positive and significant impact on the use of reading strategies when reading new texts without feedback ($g+ = 0.61$) and on reading comprehension ($g+ = 0.34$). Additionally, larger effects of feedback on reading strategy use predicted larger effects of feedback on reading comprehension. Feedback did not have an influence on motivational aspects and also no significant effect of feedback on reading comprehension was found in these studies.

Conclusions: Feedback helps students to apply reading strategies more often and/or more efficient, even in new situations where they don't receive feedback. Students are able to transfer the practiced reading strategies to new texts, which fosters reading comprehension. With the currently available studies we did not find motivational aspects to be influenced when students received feedback during a reading task.

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

Introduction

Difficulties in reading comprehension skills are a common obstacle for learning among students in all levels of education, ranging from elementary school to higher education (see e.g., Cecilia et al., 2014; Gorzycki et al., 2016; Kerr & Frese, 2017; OECD, 2018). That is, the inability to create a complete and coherent mental model of the text withholds students from being able to sufficiently understand and thereby learn from a text (see e.g., Kintsch, 1986; van den Broek et al., 2002). In order to address this issue, the development of a thorough understanding of both reading comprehension and its underlying skills as well as the effects of instruction strategies is crucial (see Israel & Reutzel, 2017). One of the vital elements of effective reading comprehension instruction is providing students with feedback in order to facilitate text comprehension (Crossley & McNamara, 2017). Decades of research have, on average, shown positive effects of feedback, i.e., individualized information in response to students' performance on assignments or questions aimed to improve learning, on reading comprehension (Swart et al., 2019). However, studies show large variances in the effects of feedback. In a recent meta-analysis, Swart et al. (2019) showed that the effect of feedback on reading comprehension differs related to two dimensions: the timing of the feedback and its richness (i.e., the amount of information provided in feedback messages). Feedback is less effective if it is provided during reading than after reading: probably because the reader is required to multitask by processing the text, the content of the feedback, and by integrating these two processes. This results in an additional load on the reader's working memory and interrupts the reading process (Sweller, 1994; Sweller et al., 1998). Additionally, the richness of the feedback influences the effect it has on reading comprehension. That is, feedback containing the correct answer or both the correct answer and hints or explanations is more effective than feedback solely stating 'right' or 'wrong'. This only holds, however, when feedback does not interrupt the reading process (i.e., is provided after reading the text). Although insight into the effects of different features of feedback is important, in order to get a thorough understanding of the effectiveness of feedback as an instructional tool, it is also crucial to investigate how feedback fosters reading comprehension. Therefore, in the present meta-analysis we aim to provide more insight in the mechanisms explaining the effects of feedback on reading comprehension. 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, when investigating the effects of feedback, we test the effects of feedback on cognitive and affective processes (i.e., the use of reading strategies and motivational aspects) that are related to reading comprehension.

From a Vygotskian perspective, feedback can be seen as a form of scaffolding aimed at reducing the gap between actual and desired performance (Bransford et al., 2000;

Sadler, 1989; 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 the function to inform the reader about misunderstandings that need to be corrected, to fill in gaps in understanding and/or to increase awareness of one's level of understanding (Ilies et al., 1996). Creating awareness of one's level of understanding is essential when teaching students to self-regulate (i.e., manage) their learning from texts (see Hoska, 1993; ter Beek et al., 2018). Self-regulated learning does not only require (meta)cognitive strategies such as inference making and monitoring comprehension, but also the will to learn (i.e., motivation). 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 of these components of self-regulated learning. Likewise, Kluger and DeNisi (1996) in their FIT state that the effects of feedback on learning performance can be explained by the combination of effects on both task-learning processes and task-motivational processes. Accordingly, in the present meta-analysis we investigate the effects of feedback on the use of reading strategies (i.e., task-learning processes) and motivational aspects (i.e., task-motivational processes) related to reading comprehension.

Feedback as a Tool to Develop Reading Strategies

Effectively applying reading strategies while reading, i.e., cognitive or behavioral actions during reading aimed at improving the understanding of the text (Graesser, 2007), such as monitoring comprehension, questioning, rereading passages, making inferences during reading and the use of background knowledge, is essential for reading comprehension (see Gersten et al., 2001; Graesser, 2007; Palinscar & Brown, 1984). As a consequence, we wonder whether feedback could help readers to develop and deploy reading strategies that are needed to improve reading comprehension. Results of intervention studies indeed have shown positive effects of feedback on question-answering while reading on comprehension monitoring, self-questioning, highlighting and strategic decision making when searching for relevant information in a text (e.g., Lee et al., 2010; Llorens et al., 2014, 2016; Sung et al., 2008). Additionally, Bransford et al. (2000) state that feedback can help students to develop comprehension monitoring skills, which they can later also apply in learning situations in which they do not receive feedback.

Although several researchers have stressed the importance of instruction in reading strategies to enhance reading comprehension in both readers with and without difficulties in reading (see e.g., Crossley & McNamara, 2017; Edmonds et al., 2009; Gersten et al., 2001; Okkinga et al., 2018; The National Reading Panel, 2000), transfer of reading strategies to new texts 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 (Swart et al., 2019). Even though most studies report on the effects of strategy instruction on reading comprehension, most studies do not test transfer effects of strategy instruction (i.e., strategy use in new texts). In order to test the effects of transfer of reading strategies to new texts and in turn on reading comprehension, interventions studies must include not only reading comprehension post-tests for the texts that are used during the interventions. It is also needed to test whether practiced reading strategies are applied when students read a new text and how this relates to comprehending this new text. However, in most studies on the effects of feedback, comprehension was measured for texts that were read during the experimental reading task that included feedback.

Feedback as Motivator

Motivated readers usually have a more positive attitude towards a reading task they are performing and are more engaged during reading. As a result, they are more willing and able to invest cognitive effort in understanding the materials they are reading, which positively influences reading comprehension (Guthrie et al., 2012; Guthrie & Wigfield, 2000). This willingness to invest cognitive effort in understanding the text is especially important in educational contexts where students are required to learn from a text. Academic texts are complex and information density is high compared to narrative texts that are read for pleasure (see van den Broek et al., 2001; Wolters et al., 2017). Motivation for reading complex academic texts is not self-evident (see e.g., Coddington, 2009; Guthrie & Wigfield, 2000; Neugebauer, 2013; Pak & Weseley, 2012) and seems to diminish both during students' school careers (Jacobs et al., 2003) and in general among adolescent students over the past 20 years (OECD, 2018). It is, therefore, important to better understand whether instructional practices have an effect on motivational aspects (for better or for worse).

A diverse range of instructional practices has been shown to positively influence motivation for reading and reading engagement (Guthrie et al., 2012; Guthrie & Wigfield, 2000; van Steensel et al., 2016). As a consequence, we wonder whether feedback could help readers to be more motivated and/or engaged during reading. Kluger and DeNisi (1996) in their FIT describe motivational mechanisms underlying feedback. The fundamental assumption of the FIT is that behaviour is regulated by comparing one's current performance with goals or standards for performance. Feedback functions as a notification that helps readers comparing their current performance (i.e., level of understanding of the text) to the goal (i.e., full understanding of the text). Assuming that readers are focussed on aligning current performance with the goal, this notification motivates students to increase cognitive effort, or engagement in order to achieve full

understanding of the text they are reading. Hattie and Timperley (2007) also argued that feedback can function as a motivator by providing the readers with awareness of their understanding (see also Kulhavy & Wager, 1993; ter Beek et al., 2018). They argue that this awareness increases readers' expectancies for success and self-efficacy and, at the same time, reduces feelings of uncertainty (Shute, 2008; Wigfield et al., 2016). In other words, feedback may be understood as a motivational input by providing feelings of autonomy and competence (Ryan & Deci, 2000). However, according to the FIT, if students do not believe that they are able to close the gap between current understanding and full understanding of the text or if they do not believe that the feedback is helpful in achieving full understanding of the text, feedback may also decrease motivation and reduce the cognitive effort that readers are willing to put in the reading task (Kluger & DeNisi, 1996). In other words, feedback could work both as a motivator and demotivator.

In line with the diverging motivational effects of feedback that are proposed from a theoretical point of view, the results of studies on the effects of feedback when students perform a reading task on motivational aspects, and as a consequence on reading comprehension, are mixed. Martin et al. (2007) found that feedback on comprehension questions during reading 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 to a control condition in which students did not receive feedback. Others showed that feedback on questions during reading did not significantly influence readers' attitudes towards the reading task in a positive or negative way, but negatively influenced reading comprehension (see e.g., Lasoff, 1981; Saunders, 1998). Jacobs and Kulkarni (1966) found that students from one junior high school rated a reading task less interesting when they received feedback on questions while performing the reading task, whereas students from another high school rated the reading task with and without feedback equally interesting. Nevertheless, feedback had a negative effect on reading comprehension in both groups.

Present Study

The aim of the present study is first to investigate whether the effects of feedback on reading comprehension can be explained by the increased use of reading strategies and by changes in motivational aspects. Second, we also wonder whether the gains in reading comprehension are greater when feedback has larger effects on the use of reading strategies or motivational aspects.

Related to the first aim, we investigate the effects of feedback on (1) the use of reading strategies when reading a new text in a reading post-test and (2) motivational

aspects, reflected by readers' attitudes or engagement towards the reading task including feedback compared to the reading task without feedback. In line with 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; Sung et al., 2008), we expect feedback to have a positive impact on the use of reading strategies. In the case of motivational aspects, both a positive or negative effect of feedback 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, 2009; Wigfield et al., 2016) a positive effect of feedback on motivational aspects could be expected (see also ter Beek et al., 2018). However, based on Kluger and DeNisi's reasoning (1996) that feedback could have a negative effect on motivation if it does not support readers' believes in their ability to gain full understanding of the text or that feedback itself is not a helpful tool to achieve full understanding, a negative effect of feedback could also be expected.

Second, in the case that feedback appears to have a significant effect on the use of reading strategies and/or motivational aspects, we then investigate if the effects sizes moderate the gains in reading comprehension. In other words, in line with the FIT, we test if the effect of feedback on the targeted learning outcome (i.e., reading comprehension) can be explained by cognitive processes (i.e., the use of reading strategies) and affective processes (i.e., motivational aspects) related to reading comprehension. 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 motivation and engagement 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 strength of the effects of feedback on the use of reading strategies and/or motivational aspects could, at least partially, explain the effects of feedback on reading comprehension.

Methods

Inclusion Criteria

The present meta-analysis is performed on studies that tested the effects of feedback on questions/tasks during or directly after reading on reading comprehension and that included statistics for at least one outcome measure for the use of reading strategies when reading a new text in a reading post-test or that included statistics for motivational aspects. Additionally, reports had to meet the following criteria: (1) an intervention study was described that compared a feedback condition to a control

condition in which participants read similar or comparable text but without receiving feedback on questions/task included in the reading task; (2) participants were conventional readers and read the informative or narrative texts themselves; and (3) reports had to be written in English. No restrictions were set for students' age or country or origin or publication status.

In line with Graesser's (2007) definition of reading strategies, we included all measures for the use of reading strategies related to cognitive (e.g., connecting information from the text to background knowledge) or behavioural actions (e.g., highlighting or clicking back to previously read information in order to being able to reread a passage) aimed at improving comprehension of the text. Measures could be 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 was collected during the reading task (e.g., rereading previous pages of text, see Llorens et al. 2014; note taking or highlighting, see Lee et al., 2010). In order to investigate the effect of feedback on motivational aspects related to reading comprehension, all self-report measures that contained questions about or information on the reader's motivation, reflected by reader's attitude towards the reading task, or engagement during reading were included in the present meta-analysis. Because a universal definition of motivation and engagement is lacking in the reading literature, motivation and engagement aspects are often commingled in measurement instruments, and both concepts function highly interactive (for a review on this topic, see Unrau & Quirk, 2014), we combined these measures in the present meta-analysis.

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 on the one hand, and feedback, scaffolding, interactivity, and tutoring on the other hand. 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 (see Appendix A), 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 motivational aspects, were coded for each study report and contrast by the first author and two trained undergraduate students. 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 κ = .92 (*SD* = .10, range .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 were more motivated (i.e., were more engaged or had a more positive attitude towards the reading task). A positive effect size for reading comprehension indicated that participants 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 et al., 2005) and inspected for outliers (standardized 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 et al., 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).

To check for publication bias, we graphically inspected funnel plots including all average effect sizes per contrast for the use of reading strategies or motivational aspects. 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 motivational aspects 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 motivational aspects and reading comprehension were included. Subsequently, in the case of a significant effect we performed a meta-regression analysis to test if the effect sizes for the effects on the use of reading strategies or motivational aspects predicted 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 on reading strategy use when reading a new text and reading comprehension and 10 contrasts that included statistics for one or more effects of feedback on motivational aspects and reading comprehension. Inspection of all effect sizes showed no outliers.

The Effect of Feedback on the Use of Reading Strategies and Reading Comprehension

Among the 8 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 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, 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 non-significant 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 8 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 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 were also accomplished.

The Effect of Feedback on Motivational Aspects and Reading Comprehension

Feedback had no significant effect on motivational aspects related to reading comprehension ($g^+ = 0.07$, $k = 10$, *SE* = 0.26, 95% CI = [-0.44, 0.58], $p = .78$). On average participants were not more or less engaged or did not have a more positive or negative attitude towards the reading task if they received feedback. Also, the average effect of feedback on reading comprehension in these 10 studies was non-significant ($g^+ = -0.02$; *SE* = 0.21, 95% CI = [-0.42, 0.38], $p = .93$).

Discussion

Thus far, research on the effects of feedback has mainly focused on design features (e.g., timing and richness) as an explanation for variance among the effects of feedback on reading comprehension found in several studies (Swart et al., 2019). However, to achieve a thorough understanding of feedback, insight in the mechanisms explaining the effects of feedback is necessary. Therefore, to further unravel the effects of feedback on reading comprehension, in the present meta-analyses we investigated the effects of feedback on cognitive processes (the use of reading strategies) and affective processes (i.e., motivational aspects) that are related to reading comprehension. This approach is in line with the FIT (Kluger & DeNisi, 1996), stating that it is crucial to understand students' total reaction to feedback including cognitive and affective aspects in addition to the effect on the targeted learning outcome (i.e., reading comprehension). Results showed that feedback had a moderate positive effect on the use of reading strategies when reading a new text. The strength of the effect of feedback on the use of reading strategies positively predicted the effect of feedback on reading comprehension. No effect of feedback was found on motivational aspects related to reading comprehension. In these studies including motivational aspects, the effect of feedback on reading comprehension was also not significant.

The Effect of Feedback on the Use of Reading Strategies

The positive effect of feedback 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) and the idea that feedback helps students to shift attention to processes needed to accomplish understanding of the text (see Hoska, 1993). Readers showed (e.g., Llorens et al., 2016) and/or reported to use (e.g., Lee et al., 2010) more reading strategies after reading tasks that included feedback than after reading tasks without 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 helps students to apply reading strategies more often and/or more efficient and they can apply these skills in new reading tasks where they don't receive feedback. So, they are able to transfer the practiced reading strategies to new texts. The ability to transfer the use of reading strategies to new texts also fosters reading comprehension in cases where students do not have the help of feedback. 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 on the effects of reading strategy instruction and feedback (see Elleman & Compton, 2017; Swart et al., 2019). So far, research has mainly shown that instruction in the use of reading strategies results in improved reading comprehension, but the direct effect of reading strategy instruction on strategy use in new texts was only sparsely empirically tested. The present meta-analysis contributes to filling this gap and showed that feedback can be used as an effective tool in reading strategy instruction, thereby promoting the use of reading strategies and thus reading comprehension.

Although Swart et al. (2019) showed that feedback is most effective for supporting understanding of a text if provided directly after reading, in six out of eight contrasts in the present meta-analysis feedback was provided during reading. Possibly, feedback during reading is less effective in supporting the understanding of a text 'on the job' (i.e., understanding of the text that a student is currently reading), but might facilitate the teaching of 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 model for readers on how to effectively integrate information in the text into a coherent mental model, comparable to modelling approaches in reading comprehension instruction (see Afflerbach et al., 2020; Duke & Pearson, 2008). As a consequence, future research should focus on the effects of different features of feedback (e.g., richness and timing) in relation to these two functions of feedback: feedback as a tool to support understanding of

a text 'on the job' and feedback as a tool for reading strategy instruction to foster reading comprehension skills that could be transferred to contexts in which the reader does not receive feedback.

The results of the present study have to be interpreted with some caution. Due to the wide variety in primary studies on the effects of feedback we were only able to include eight studies in which effects of feedback on both strategy use and reading comprehension were included. However, the found effect of feedback on the use of reading strategies is robust as the fail-safe *N* indicated that 91 contrasts with a null-effect are needed to turn the significant effect of feedback on reading strategies into a non-significant one (see also Fragkos et al., 2014). As a consequence of the limited number of studies, we were not able to investigate the interplay of design features of feedback (e.g., timing and richness) and the two different instructional perspective (i.e., feedback as support for reading comprehension 'on the job' and feedback as an instructional tool to teach reading comprehension skills). 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 different age groups of students. Due to the limited number of studies, we were not able to draw conclusions on this matter in the present meta-analysis.

The Effect of Feedback on Motivational Aspects

Theoretical perspectives on the motivational effects of feedback considered both positive effects and negative effects. Based on the goal-setting theory and control theory (see Kluger & DeNisi, 1996), stating that feedback provides 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 on motivational aspects could be expected (see also ter Beek et al., 2018). However, based on Kluger and DeNisi's reasoning (1996) that feedback could also have a negative effect on motivation if it does not support readers' believes in their ability to gain full understanding of the text or that feedback itself is not a helpful tool to achieve full understanding, a negative effect of feedback could also be expected. Results of the present meta-analysis showed that participants were on average not more engaged or did not rate the reading tasks more positively or negatively when these included feedback. In other words, based on the available research we cannot conclude if feedback functions as a motivator or as a demotivator.

Possibly, the lack of a motivational effect 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 & DeNisi's (1996) FIT, feelings of autonomy and competence might only increase when the gap between the actual and desired performance can be bridged by the feedback (see also Bransford et al., 2000; Sadler, 1989; 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. Also, research has shown that students particularly allocate attention to feedback on incorrect answers. As a consequence, poor performing students spend more time on negative feedback than good performing students (see Máñez et al., 2019), which has been shown to decrease motivation (Fong et al., 2019). In sum, possibly the combination of motivating and demotivating effects that have been found in different subgroups of students could have resulted in the average null-effect that was found in the present study.

Additionally, the questionnaires used in the primary studies targeted a wide range of motivational aspects ranging from interest and engagement (e.g., Jacobs & Kulkarni, 1966) to participants' attitudes towards learning experiences (i.e., perceived usefulness; Chen et al., 2011) and teaching methods or programs used for the reading tasks (e.g., "I would enjoy using other computer programs like this one in future lessons"; Martin et al., 2007). In future research, features of feedback should be systematically tested in relation to different motivational mechanisms (i.e., motivation, interest, engagement, attitude) and how these affect different groups of students (e.g., good and poor comprehenders, see Máñez et al., 2019). Insight in these motivational processes may also further unravel why, on average, no effect of feedback on reading comprehension was found in the studies included in the present meta-analysis.

Conclusions

In the present meta-analysis we aimed to explain the effects of feedback by unravelling the effects of feedback on the use of reading strategies and motivational aspects related to reading comprehension. On the one hand, combining the results of 8 studies that measured the effects of feedback on both the use of reading strategies and reading comprehension showed that feedback positively influenced readers' ability to deploy reading strategies even in situations where they don't receive feedback. This transfer of reading strategy skills consequently related to improved reading comprehension. On the other hand, combining the results of 10 studies that included information on the effects of feedback on both motivational aspects and reading comprehension showed that feedback did not function as motivational input for the readers. Readers were neither more nor less motivated, engaged or positive towards the reading tasks. Also, no effect of feedback on reading comprehension was found in these studies. Although the number of studies in the present meta-analysis is limited, the

presented effect of feedback on the use of reading strategies appeared to be robust. As a consequence, the present study extends prior research on the effects of feedback on reading comprehension and should be interpreted as a starting point for future research on the use of feedback as an instructional tool to support and teach reading comprehension.

Table 1

Overview of Studies Included in the Meta-Analysis

Authors	Year	*N* feedback	*N* control	Age group	Outcome	Effect size (Hedges'*g*)
Chen et al.	2011A	19	19	Students	Comprehension	0.05
					Motivation	-0.20
Chen et al.	2011B	20	20	Students	Comprehension	0.67
					Motivation	0.29
Jacobs & Kulkarni	1966A	15	12	Secondary	Comprehension	-0.91
					Motivation	-1.47
Jacobs & Kulkarni	1966B	19	9	Secondary	Comprehension	-0.39
					Motivation	0.05
Lasoff	1981	12	12	Students	Comprehension	-0.32
					Motivation	0.28
Lee et al.	2010	74	74	Students	Comprehension	0.54
					Strategy use	1.56
Llorens et al.	2014A	30	14	Secondary	Comprehension	0.67
					Strategy use	0.80
Llorens et al.	2014B	34	14	Secondary	Comprehension	0.35
					Strategy use	0.28
Llorens et al.	2016A Exp. 1	51	25	Secondary	Comprehension	0.10
					Strategy use	-0.17
Llorens et al.	2016B Exp. 1	41	25	Secondary	Comprehension	0.16
					Strategy use	0.37
Llorens et al.	2016C Exp. 2	38	37	Secondary	Comprehension	0.05
					Strategy use	0.10
Martin et al.	2007	43	43	Students	Comprehension	1.11
					Motivation	1.53
Saunders	1998A	17	17	Students	Comprehension	-0.14
					Motivation	-0.03
Saunders	1998B	17	17	Students	Comprehension	-0.44
					Motivation	0.01
Sung et al.	2008A	31	35	Primary	Comprehension	0.22
					Strategy use	0.89
Sung et al.	2008B	34	30	Primary	Comprehension	0.54
					Strategy use	0.97
Wentling	1973A	39	19	Secondary	Comprehension	0.17
					Motivation	0.55

Authors	Year	*N* feedback	*N* control	Age group	Outcome	Effect size (Hedges'*g*)
Wentling	1973B	39	20	Secondary	Comprehension	-0.31
					Motivation	-0.54

Note. Students = (university or college) students, Primary = primary school children, Secondary = secondary school children

Figure 1

Flow Diagram of the Literature Search Process

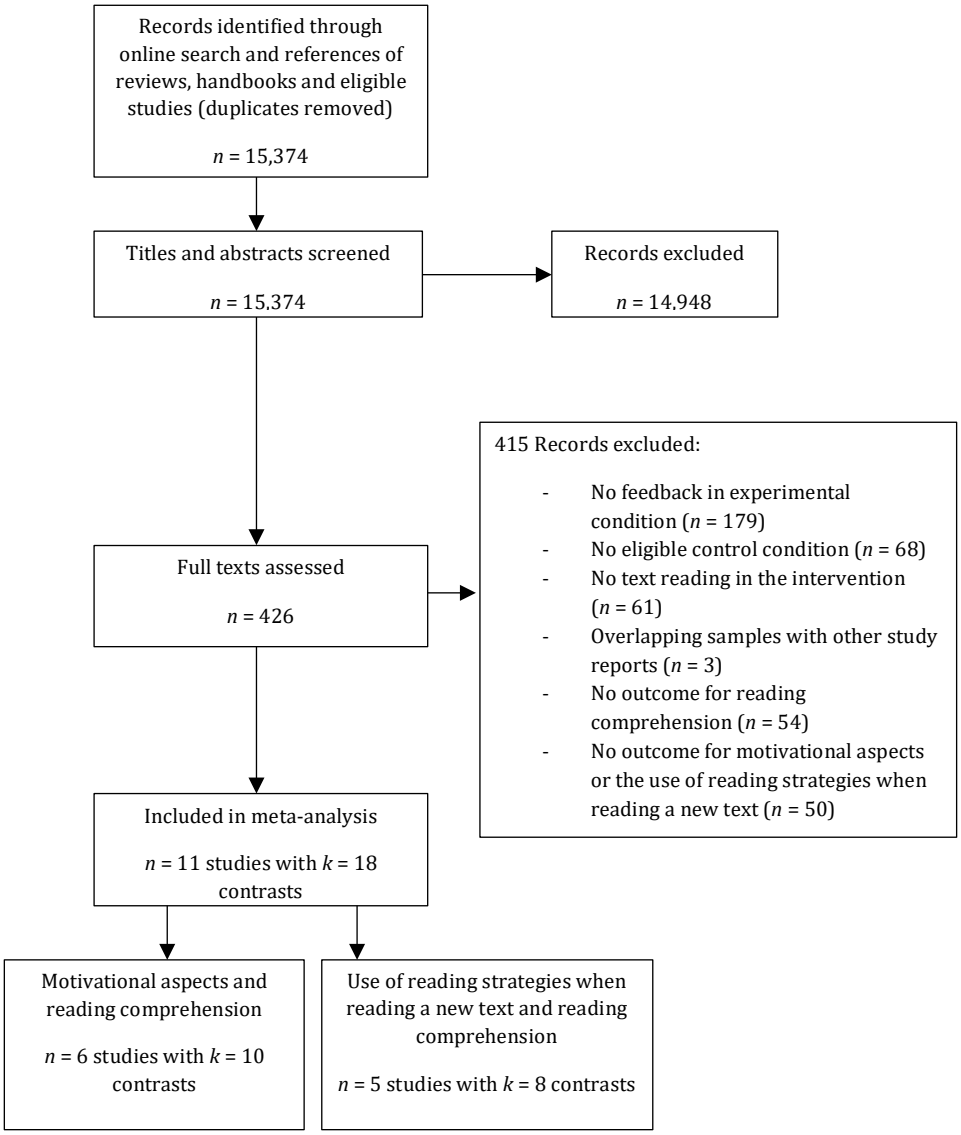
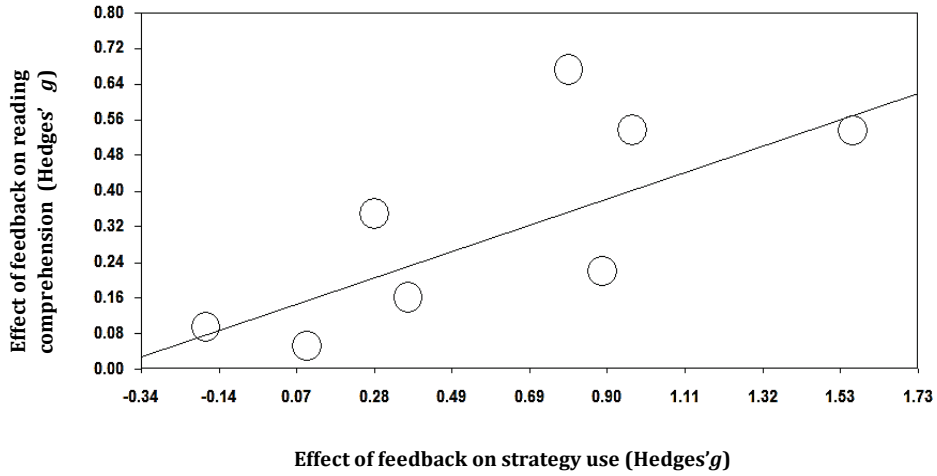


Figure 2

Results of Meta-Regression Analysis (k=8) of the Magnitude of the Effect of Feedback on the Use of Reading Strategies as Predictor of the Effect of Feedback on Reading Comprehension.



Appendix A

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