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Published in:

Educational Psychology Review

Publication status and date:

Published: 11/02/2023

DOI (link to publisher):

[10.1007/s10648-023-09719-3](https://doi.org/10.1007/s10648-023-09719-3)

Document Version

Publisher's PDF, also known as Version of record

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Citation for the published version (APA):

van der Sande, L., van Steensel, R., Fikrat-Wevers, S., & Arends, L. (2023). Effectiveness of Interventions that Foster Reading Motivation: a Meta-analysis. *Educational Psychology Review*, 35(1), Article 21. <https://doi.org/10.1007/s10648-023-09719-3>

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Effectiveness of Interventions that Foster Reading Motivation: a Meta-analysis

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Accepted: 30 September 2022
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Abstract

Many students have low reading motivation. Based on (reading) motivation theories, several mechanisms are distinguished that can foster reading motivation. Our goal in this meta-analysis was to examine the effects of theory-driven reading motivation interventions in school on students' reading motivation and reading comprehension as well as to test which mechanisms are particularly effective in fostering motivation and comprehension. We conducted a literature search in ten online databases and identified 39 relevant effect studies. Positive effects on affirming motivations ($d = 0.38$), extrinsic motivations ($d = 0.42$), combined motivations ($d = 0.17$), and reading comprehension ($d = 0.27$) were found. The effect on undermining motivations ($d = -0.01$) was not significant. In particular, interventions that aimed to trigger interest had positive effects on affirming motivations and reading comprehension. Furthermore, effects on affirming motivations were larger if the total duration of the intervention was longer and if the share of boys in the sample was higher. Interventions delivered by researchers had larger effects on reading comprehension than interventions delivered by teachers. Finally, effects on reading comprehension were larger for primary schoolers than for secondary schoolers and larger for typical readers than for struggling readers. Implications for practitioners, policymakers, and researchers are discussed.

Keywords Reading · Motivation · Comprehension · Interventions · Meta-analysis

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Introduction

Substantial numbers of students have problems comprehending texts. They are not able to perform reading tasks at the level considered the minimum required to participate fully in society (OECD, 2019a) and experience difficulties in school, as understanding texts is needed to acquire knowledge in different content domains (Reschly, 2010; Snow, 2002). These problems are partly related to students' reading motivation, which can be defined as "the drive to read resulting from a comprehensive set of an individual's beliefs about, attitudes towards, and goals for reading" (Conradi et al., 2014, p. 154). Research shows that students who are motivated to read, read more often and have better reading comprehension ability (Mol & Bus, 2011; Schiefele et al., 2012; Toste et al., 2020). However, substantial numbers of students have low reading motivation levels and only read infrequently (Nippold et al., 2005; OECD, 2019b; Strommen & Mates, 2004). Therefore, it is argued that reading instruction should not only focus on skills instruction but also on the promotion of reading motivation (e.g., De Naeghel & Van Keer, 2013; Vaknin-Nusbaum et al., 2018). The first aim of the current meta-analysis was to investigate to what extent theory-driven reading motivation interventions in school can contribute to higher reading motivation and whether this is accompanied by an increase in reading comprehension. Our second aim was to get more insight into what are effective ways to foster reading motivation.

Effects of Reading Motivation Interventions: Previous Meta-analyses

So far, a few meta-analyses have been conducted in which the effects of reading motivation interventions have been synthesized and compared systematically. Guthrie et al. (2007) investigated the effects of Concept-Oriented Reading Instruction (CORI) on reading comprehension and different motivational variables, such as intrinsic motivation and self-efficacy. In CORI, motivational support and strategy instruction are combined in a content domain (e.g., science). Mean effect sizes for motivation ranged from Cohen's $d = 0.12$ to 1.20 , with a median of 0.30 . Mean effect sizes for reading comprehension were larger, ranging from Cohen's $d = 0.65$ to 0.93 . More recently, Unrau et al. (2018) and McBreen and Savage (2020) examined the outcomes of a broader array of motivational interventions. Unrau et al. (2018) tested effects on reading self-efficacy and found a weighted mean effect size of Hedge's $g = 0.33$. McBreen and Savage (2020) established mean effect sizes of Hedge's $g = 0.30$ on reading motivation and Hedge's $g = 0.20$ on reading achievement.

These meta-analyses have a number of shortcomings. The reviews by Guthrie et al. (2007) and Unrau et al. (2018) have a limited scope, targeting either one specific intervention or one specific outcome measure, thereby possibly overlooking relevant results of other kinds of interventions or on other types of variables. The meta-analysis by McBreen and Savage (2020) is more comprehensive but has three other drawbacks. First, the authors have included interventions both with and without a theoretical basis, which makes it difficult to draw conclusions on the mechanisms that steer intervention effects. Second, their meta-analysis includes both targeted and broad interventions, the latter including programs that combine motivational and

other types of support (i.e., skills instruction). Since they do not use this variable as a moderator, definite conclusions on the effects of motivational support cannot be drawn: positive outcomes might very well be the result of other elements of the intervention. Third, McBreen and Savage (2020) based their moderator analyses on one, undifferentiated reading motivation variable, covering such concepts as intrinsic motivation, self-efficacy, value, and extrinsic motivation. However, not all forms of motivation are equally beneficial for reading outcomes.

The present meta-analysis aims to meet these shortcomings in four ways. First, we take a broad scope; that is, we analyze the effects of a range of motivational programs on a variety of motivational outcomes. Second, we limit ourselves to theory-based interventions. This allows us to test which theoretical mechanisms contribute to the promotion of reading motivation and comprehension, thereby providing better insights into the effective ingredients of motivational interventions (see “[Motivational mechanisms](#)” for further explanation). Third, we aim to draw conclusions on the added value of motivational interventions by testing whether effects differ between programs that combine motivational support with skills instruction and those that do not. Fourth and finally, we apply a more differentiated approach to the moderator analyses. We based our approach on an analysis of the extent to which different types of motivation are beneficial for reading development. Based on previous conceptualizations of reading motivation (Schiefele et al., 2012; Guthrie & Coddington, 2009), we categorized motivational outcomes as *affirming* (e.g., intrinsic motivation and reading self-efficacy), *extrinsic* (e.g., reading for competition and recognition), or *undermining* (e.g., avoidance goals and perceived difficulty of reading). Affirming motivations are found to be most favorable for students’ reading achievement, whereas undermining motivations are unfavorable (Guthrie & Coddington, 2009; Guthrie et al., 2013; Ho & Guthrie, 2013; Van Steensel et al., 2019). Extrinsic motivations have been found to have small, no, or even negative effects on reading achievement (Becker et al., 2010; Schaffner et al., 2013; Schiefele et al., 2012; Stutz et al., 2016).

Reading Motivation Theories

Motivation is a complex construct with multiple dimensions (Conradi et al., 2014; Murphy & Alexander, 2000; Schiefele et al., 2012; Wigfield, 1997). These dimensions are elaborated in various motivation theories, which are also applied in the field of reading motivation (Conradi et al., 2014; Cook & Artino, 2016; Guthrie & Wigfield, 1999; Linnenbrink-Garcia et al., 2016; Wigfield, 1997). Influential motivation theories are self-determination theory (SDT; Ryan & Deci, 2000), expectancy-value theory (EVT; Wigfield & Eccles, 2000), social cognitive theory (SCT; Bandura, 1986), interest theory (IT; Hidi & Renninger, 2006; Krapp, 2002), achievement goal theory (AGT; Ames, 1992; Pintrich, 2000), and attribution theory (AT; Weiner, 1985). An adjacent model that is relevant to the field of reading motivation research is the reading engagement model (REM; Guthrie et al., 2007). Table 1 provides an overview and description of these theories.

Table 1 Overview of influential (reading) motivation theories

Theory	Description
Self-determination theory	SDT distinguishes between intrinsic and extrinsic motivation (Ryan & Deci, 2000). Intrinsic motivation is fully internalized and refers to engaging in an activity because it is inherently enjoyable. Extrinsic motivation refers to engaging in an activity to achieve some external goals and is subdivided into different categories, ranging from least to most internalized: external, introjected, identified, and integrated regulation. Internalization of motivation is driven by whether the basic psychological needs of autonomy, competence, and relatedness have been met (Niemic & Ryan, 2009; Ryan & Deci, 2000)
Expectancy value theory	Motivation is influenced by expectations of success and subjective task value. Expectancies refer to students' beliefs about their capabilities to perform a task successfully and values reflect reasons for doing an activity (Wigfield & Eccles, 2000). Four types of values are distinguished: (1) intrinsic value, which means that a topic or activity is considered enjoyable; (2) attainment value, which is the personal importance attached to mastering a skill; (3) utility value, which is the usefulness of a specific task or skill, for example, to reach future goals; and (4) costs, the costs accompanied by performing a task, for example, in terms of time and energy (Wigfield & Eccles, 2000)
Social cognitive theory	According to SCT, human behavior results from interactions between personal, behavioral, and environmental factors. A key concept in this theory is self-efficacy, which represents a person's sense of being able to succeed in a task. Self-efficacy can be acquired by various (social) experiences: particularly mastery experiences are a driving force in students' self-efficacy (Bandura, 1986)
Interest theory	Interest theory proposes that motivation is triggered by a preference for certain topics, subject areas, or activities (Schiefele, 1991). Interest can either be situational, which can be defined as the temporary interest aroused by features of an activity, or individual, which is a relatively stable characteristic of a person (Hidi & Renninger, 2006; Krapp, 2002)
Achievement goal theory	Three types of goals can be identified: mastery goals (focus on developing competence and personal improvement), performance-approach goals (focus on demonstrating competence and outperforming others), and performance-avoidance goals (focus on avoiding failure and appearing incompetent; Ames, 1992; Elliot, 1999; Pintrich, 2000). Mastery goals are often associated with higher motivation and more favorable outcomes than performance-approach goals, whereas performance-avoidance goals are generally associated with negative outcomes (Ames, 1992; Elliot, 1999; Van Yperen et al., 2015)
Attribution theory	Learners create subconscious attributions of success and failure. These attributions vary in terms of locus, stability, and controllability and are related to the amount of control students feel over their learning (Weiner, 1985). Students who feel in control over their learning will be more motivated to put effort into a task
Reading engagement model	REM is based on various motivation theories (SDT, SCT, and AGT; Guthrie et al., 2007). Engaged reading refers to both motivated and strategic interaction with texts, correlates with reading comprehension, and can be fostered by educational practices. It is assumed that if motivational and strategy support are combined, engaged reading and reading comprehension are enhanced (Guthrie et al., 2004)

Motivational Mechanisms

Together, the theories described in Table 1 propose several mechanisms through which affirming motivations, in particular, can be fostered. Feelings of autonomy, relatedness, and competence are central to SDT, which posits that motivation becomes more internalized to the extent that these psychological needs are met (Niemic & Ryan, 2009; Ryan & Deci, 2000). Applied to reading, autonomy can for example be supported by offering students a choice of texts (Stefanou et al., 2004). Positive interactions about books and collaboration in the classroom can contribute to feelings of relatedness (Guthrie et al., 2004; Nolen, 2007). Feelings of competence can be fostered by matching texts to students' reading levels, by teaching strategies that support text comprehension, or by providing supportive feedback (Bandura, 1997; Margolis & McCabe, 2003; Walker, 2003). The need for competence is also central to EVT and SCT, which assume that expectancies of success and self-efficacy, respectively, promote students' motivation to engage in activities such as reading (Bandura, 1986; Cook & Artino, 2016; Linnenbrink-Garcia et al., 2016; Wigfield, 1997; Wigfield & Eccles, 2000).

In IT, interest is considered a driving force in student motivation and learning (Hidi & Renninger, 2006; Krapp, 2002). Students' interest could, for example, be triggered by the use of interesting texts (Ryan & Deci, 2000; Schiefele, 1999) or by making real-world connections (Guthrie et al., 2007). The concept of interest also resounds in the concept of intrinsic value in EVT (Cook & Artino, 2016; Schiefele et al., 2012; Wigfield, 1997).

Based on AGT, stimulating (mastery) goals for reading may have beneficial effects on students' reading motivation (Ames, 1992; Elliot, 1999; Pintrich, 2000). Mastery goals can be stimulated by stressing individual development instead of making social comparisons (Ames, 1992) and by integrating reading activities in "thematic units" to build expertise (Guthrie et al., 2004).

According to AT, motivation could be fostered by changing students' attributions for learning. For example, if teachers emphasize that effort leads to success in reading and that failure is not caused by a lack of ability, this is expected to lead to more favorable attributions (Toland & Boyle, 2008; Weiner, 1985).

In REM, motivational support and strategic instruction are combined. As REM is based on SDT, SCT, and AGT, the motivational mechanisms of these theories are central to REM (Guthrie et al., 2007). According to REM, motivation is fostered if students' interest is triggered; feelings of autonomy, relatedness, and competence are supported; and mastery goals are pursued (Guthrie et al., 2004).

Interventions may also focus on stimulating extrinsic forms of reading motivation. EVT encompasses values that are more external to students: attainment value and utility value, which could be fostered by emphasizing why reading is relevant and how developing one's reading skills may help to reach future goals (Guthrie & Klauda, 2014; Wigfield & Eccles, 2000). According to SDT, extrinsic motivators, such as rewards, may be expected to contribute to extrinsic motivations (Ryan & Deci, 2000). However, given the outcomes of previous research (Becker et al., 2010; Schaffner et al., 2013; Schiefele et al., 2012; Stutz et al., 2016), we do not expect

interventions that mainly target extrinsic forms of motivation to positively contribute to students' reading development.

Other Possible Moderators of Intervention Effects

In addition to the effects of motivational mechanisms, we were interested in other variables that might moderate intervention effects. These variables can be categorized as intervention, sample, study, and measurement characteristics.

Regarding intervention characteristics, we were first of all interested in whether effects differed between programs that focused on motivation only and programs that combined motivational support with other types of support. As explained earlier, inherent to many programs is that they combine motivational support with skills instruction, which makes it difficult to infer whether effects are caused by investing in student motivation (McBreen & Savage, 2020). Comparing programs that also include skills instruction with those that do not can provide an indication of the unique contribution of motivational support: such a comparison enables to analyze whether effects are still present when skills instruction is left out of the equation.

In addition, we were interested in moderators such as text genre, program duration, and the provider of the intervention. Students' reading motivation may vary across different text genres: several studies indicate that students are more motivated to read narrative texts than informational texts (Guthrie et al., 2007; Lepper et al., 2021; McGeown et al., 2020; Parsons et al., 2018). It is thus interesting to examine whether focusing on a specific genre has consequences for intervention effects. Concerning the duration of the intervention, we focused both on the number of sessions and the total amount of time students were exposed to the intervention. Although it may be expected that interventions are more effective if the duration of the intervention is longer, no effect of length of treatment was found in the meta-analysis by Unrau et al. (2018), indicating that longer interventions were not necessarily more effective than shorter interventions. Regarding the provider of the intervention, programs delivered by researchers may be more effective than those by teachers, as the former might be better able to deliver the interventions as intended (Edmonds et al., 2009; Okkinga et al., 2018).

Particular subgroups—secondary schoolers, struggling readers, and boys—are at greater risk of having low reading motivation (Baker & Wigfield, 1999; Gottfried et al., 2001; Jacobs et al., 2002; Logan & Johnston, 2009; McKenna et al., 1995; McKenna et al., 2012; Parson et al., 2018; Toste et al., 2020; Vaknin-Nusbaum et al., 2018). Therefore, we were interested in whether interventions were more effective for these groups of students: we tested whether intervention effects were moderated by sample characteristics such as educational stage (primary versus secondary education), reading level, and gender.

Furthermore, we were interested in study characteristics such as how students were assigned to experimental and control groups, whether control groups received any treatment, and implementation quality. These variables might have consequences for the validity of conclusions on intervention effects. For instance, if students are not randomly assigned to experimental and control groups, differences between the

groups might be explained by factors other than the intervention (Lispey, 2003). If part of the intervention is also offered to the control group, differences between the experimental and control group may be less pronounced (Wilson & Lipsey, 2001).

We also tested the effects of two measurement characteristics: measurement type and whether instruments were developed within the context of the study. For measurement type, a distinction was made between self-reports, teacher-reports, observations, and tests. Instruments that were developed within the context of the study may be expected to be more closely related to the content of an intervention, and therefore yield larger effects than study-independent measures (McBreen & Savage, 2020; Wilson & Lipsey, 2001). Operationalizations of all moderators are described in the “Method” section.

Research Questions

The objectives of the current meta-analysis resulted in the following research questions:

1. What are the effects of reading motivation interventions on reading motivation and reading comprehension?
2. Which intervention, sample, study, and measurement characteristics moderate intervention effects?

Method

Literature Search and Selection Criteria

Eight electronic databases were searched: Embase (via [embase.com](https://www.embase.com)), MEDLINE, and PsycINFO (via Ovid), Web of Science, Scopus, ERIC, and CINAHL (via EBSCOhost), and Cochrane Central (via Wiley). Additional references were retrieved from PubMed (the subset as supplied by the publisher, containing the most recent, nonindexed articles) and Google Scholar. The search strategies were designed by the researchers together with an experienced librarian. Three sets of terms were combined: terms for *reading*, for *motivation*, and for *educational interventions* or *programs*. All terms were thesaurus terms and words in the title and/or abstract. A broad filter for studies related to children (aged 6 to 18 years) was used. The search was limited to articles published in peer-reviewed journals, to increase the probability of including studies with high methodological quality. A full overview of the search strategies for all databases can be found in the “Supplementary Information.” In the initial search, which was carried out on 8 April 2019, 9326 titles were identified, of which 5723 remained after removing duplicates. An update of the search on 6 May 2022 resulted in 3803 additional titles, of which 2166 remained after removing duplicates. Studies were included if they met the following criteria: (a) the effects of an intervention aimed at fostering reading motivation were

analyzed, (b) the intervention was based on a (reading) motivation theory, (c) the intervention was conducted at school, (d) the study focused on children in the range from Grade 1 until the end of secondary school, (e) the study contained an experimental and control group, (f) the dependent variables included measures of reading motivation, and (g) the study provided effect sizes or information allowing the calculation of effect sizes (sample size, means, and SD's, or results of statistical testing). Studies were excluded (a) if the paper was in another language than English, (b) if the focus of the intervention was on reading in a foreign language, and (c) if the study focused on specific target groups (e.g., children with learning, emotional, or behavioral disorders).

All results of the initial literature search were screened on title and abstract according to these criteria by the first and third authors. The results of the search update were screened by the first author and a graduate student. They screened and coded all titles independently. Full texts of possibly relevant studies were assessed on the same criteria to compile the final selection. If articles were not directly accessible, we tried to retrieve them by contacting the authors. For five possibly relevant articles, we were not able to retrieve the full text. If studies were eligible, but the statistical data reported were insufficient to be included in the meta-analysis, we e-mailed the authors to request the necessary information. In this way, we received additional data for four studies. This final stage of screening led to the inclusion of 33 studies in the initial search and six studies in the search update. Thus, 39 studies were included in the meta-analysis. We additionally consulted the reference lists of the meta-analyses by Guthrie et al. (2007) and McBreen and Savage (2020). However, this did not lead to the inclusion of any additional studies. All studies in these meta-analyses that met our inclusion criteria were already identified by our literature search. Interrater agreement for the selection of studies was 99.6%. Disagreements were discussed until an agreement was reached. For a schematic overview of the selection procedure, see the flow chart in Fig. 1.

Coding Procedure

All included studies were coded according to a scheme, which was developed and pilot-tested by the first and second authors. The scheme allowed the coding of bibliographic information, intervention characteristics, sample characteristics, study characteristics, and measurement characteristics. All studies of the initial search were double-coded by the first and third authors. Studies of the search update were double-coded by the first author and a graduate student. Interrater agreement was 90.3% (range: 80.4% to 100%). Interrater agreement was lowest for the number of sessions and the total duration of the intervention, often because the information provided by the primary studies was unclear. All disagreements were discussed until a consensus was reached.

The following bibliographic information was recorded: title of the article, author name(s), and publication year. In the "Intervention Characteristics" section, the name of the intervention was registered and codes were given for its theoretical basis, the motivational mechanism(s) it tried to elicit, whether skills instruction was

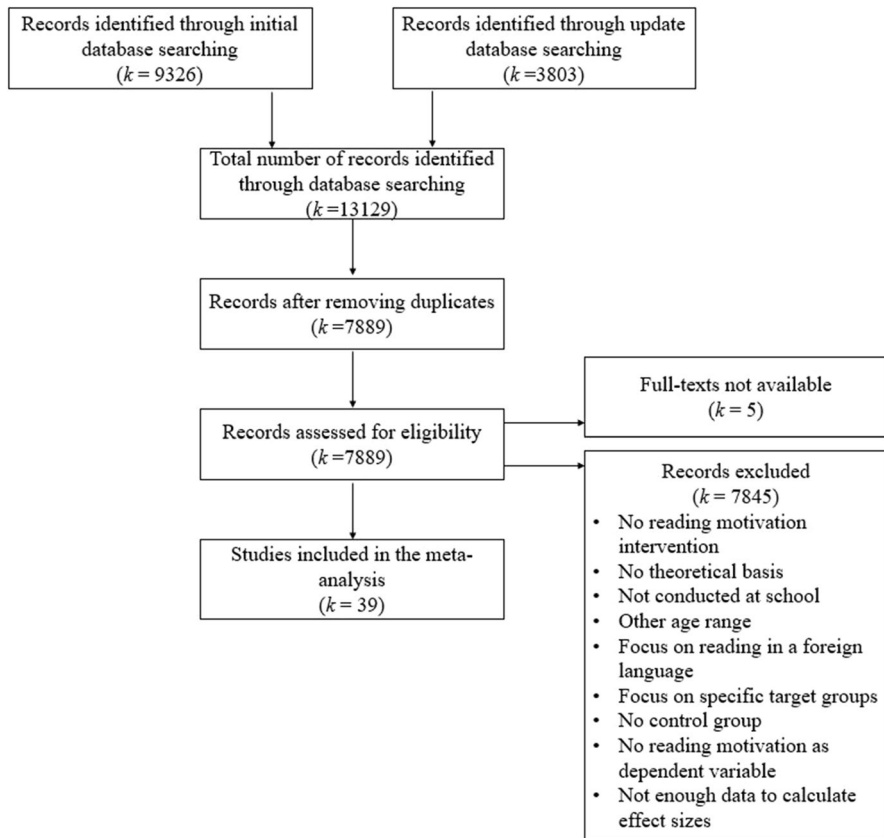


Fig. 1 Flow chart of study selection in the meta-analysis

provided, the type of texts used in the intervention, the provider of the intervention, the number of sessions, and the total duration of the intervention. Interventions were only coded as based on a specific theory if the theory itself, key theorists, and/or key concepts of the theory were explicitly mentioned and linked to the content of the intervention. Regarding motivational mechanisms, we coded whether the intervention aimed to support autonomy, relatedness, or feelings of competence, trigger interest, stimulate mastery goals, change attributions, emphasize the value of reading, or whether it offered extrinsic motivators. Interventions were coded as providing skills instruction if motivational support was, for example, complemented by reading strategy instruction or fluency practice. Concerning text genre, we specified whether narrative texts, informational texts, or both were used. In some interventions, no texts but only sentences or words were used for reading. The assumption underlying such studies is that increased feelings of competence in word reading may also increase students' motivation for reading texts (Toste, 2017, 2019). We also specified whether the intervention was delivered by researchers or not. Finally,

the number of sessions and total duration of the intervention (the number of sessions multiplied by the duration of one session) were registered.

Samples were described according to the following variables: gender, educational stage, and reading level. We specified the percentage of boys in the sample, made a distinction between primary and secondary schoolers (as indicated in the original study), and we specified whether the sample consisted mainly of struggling readers. A sample was considered to consist mainly of struggling readers if the authors reported that at least 50% of the participants lagged in reading achievement (e.g., based on standardized test scores).

Concerning study characteristics, information was recorded on the design of the study, control group type, and implementation quality. We distinguished experiments and quasi-experiments. Studies were only coded as an experiment if randomization was applied at the individual level. If classes or schools were randomly assigned to the experimental and control condition, this was considered a quasi-experimental design. For all control groups, we specified whether they also received (part of) an intervention, which may have contributed to their reading motivation and/or reading comprehension. Furthermore, we registered information about implementation quality. However, many studies did not report on implementation quality (38.5%) or, if they did, the available information varied considerably. Therefore, we had to exclude this variable from the analyses.

Concerning measurement characteristics, we first coded whether the effect measures pertained to reading motivation or reading comprehension. We focused on reading comprehension as indicator of reading achievement, as gaining meaning and knowledge from a text can be considered the main purpose of reading (Snow, 2002). All motivation variables were further categorized as affirming, extrinsic, or undermining. Intrinsic motivation, self-efficacy, mastery goals, perceived autonomy, social motivation, and intrinsic value of reading are considered (aspects of) affirming motivations (Guthrie & Coddington, 2009). Performance goals, reading for competition, and recognition were coded as extrinsic reading motivations (e.g., Guthrie & Coddington, 2009; Wigfield & Guthrie, 1997). Undermining motivations include constructs such as avoidance goals or reading anxiety (Guthrie & Coddington, 2009; Van Steensel et al., 2019). Some measures comprised indicators of more than one category (e.g., both intrinsic and extrinsic motivation), so a fourth category was added (combined motivations). Furthermore, we coded whether the post-test was immediately after the intervention or delayed, which type of measurement was used, and whether instruments were developed within the context of the study or study-independent measures (e.g., standardized tests) were used. Finally, we entered the statistical information necessary to compute effect sizes (mean, *SD*, and *n*, or, if unavailable, test statistics such as *t* or *F*) or the effect sizes (Cohen's *d*, Hedges' *g*, or η^2) provided by the authors.

Data Analysis

Because some studies included more than one experiment, experimental condition, or subsample, "experimental comparison" was used as the basis for the analyses.

We first computed a weighted effect size for affirming motivations, extrinsic motivations, undermining motivations, combined motivations, and/or reading comprehension per experimental comparison (using the standardized mean difference: Cohen's d), for which we used the available statistical information. Some studies included one instrument with several subscales; in such cases, we selected the overall scale. If a study included several indicators of reading motivation or reading comprehension, we aggregated the effect sizes per experimental comparison to prevent that the same experimental condition was included multiple times in the analyses and thus had a disproportionate contribution to the average effect.

If present, we used both pre-test and post-test data for computing effect sizes. In some studies, no means and SD s were provided. In these cases, we used the effect sizes provided by the authors or computed the effect sizes based on statistical data such as t values, F values, and p values, together with information on sample size.

We computed mean effect sizes for all outcome measures based on random-effects models, in which heterogeneity across studies is taken into account. To account for differences in sampling error related to sample size, random effects models weigh the mean effect size by the variance of the sample as well as by the variance between studies. To examine whether the variance in effect sizes between studies was related to intervention, sample, study, and measurement characteristics, we conducted moderator analyses based on categorical models analogous to ANOVA and with meta-regression in the case of continuous moderator variables. To test the between-group differences in the categorical random-effects analysis, we calculated the Q -statistic for between-group means. In the random-effects meta-regression models, we tested the significance of the individual regression coefficients with a Z -test.

Finally, we looked for indications of publication bias (Lipsey & Wilson, 1993). Duval and Tweedie's trim and fill method (Duval & Tweedie, 2000) indicated that the effect size for affirming motivations of 0.38 [0.25;0.50] would change into 0.47 [0.34;0.60] after correction for publication bias with eight trimmed studies. The presence of publication bias was not confirmed by Egger's linear regression test for asymmetry (intercept = 0.83; $SE = 0.71$; $t(53) = 1.17$, $p = .25$; Egger et al., 1997). For reading comprehension, Egger's linear regression test for asymmetry indicated significant publication bias (intercept = 2.17, $SE = 0.74$, $t(37) = 2.93$, $p = .01$). Duval and Tweedie's trim and fill method only revealed two trimmed studies. After correction for publication bias, the effect size would slightly change from 0.27 [0.17;0.37] to 0.30 [0.19;0.40]. Thus, weak indications for publication bias were found, but after correction for publication bias, effects would be larger instead of smaller. All analyses were performed by Author 4, using a registered copy of the Comprehensive Meta-Analysis statistical software (version 3.0; Biostat, Englewood, NJ).

Results

Description of the Interventions

The 39 studies included in this meta-analysis encompass 40 interventions. An overview of all studies is provided in Appendix 1. Four programs were examined in more

than one study. CORI was evaluated in four studies (studies 10, 11, 36, and 37). Learning Strategies Curriculum (Study 5 and 6), United States History for Engaged Reading (Study 29 and 30), and Multisyllabic Word Reading + Motivational Beliefs (Study 32 and 33) were evaluated twice. The remaining interventions were included once.

Most interventions were based on the reading engagement model ($n = 11$; 28%). The other interventions were based on self-determination theory ($n = 6$; 15%), interest theory ($n = 4$; 10%), expectancy-value theory ($n = 3$; 8%), attribution theory ($n = 3$; 8%), social cognitive theory ($n = 3$; 8%), and achievement goal theory ($n = 2$; 5%). Eight interventions (20%) were based on a combination of motivation theories, namely, AGT and SCT ($n = 3$; 8%), AGT and SDT ($n = 2$; 5%), IT and SDT ($n = 1$; 3%), IT and REM ($n = 1$; 3%), and REM and EVT ($n = 1$; 3%).

Regarding motivational mechanisms, most interventions aimed to trigger interest ($n = 21$; 53%), foster feelings of competence ($n = 20$; 50%), support relatedness ($n = 14$; 35%), stimulate mastery goals ($n = 13$; 33%), or support autonomy ($n = 12$; 30%). In a smaller number of interventions, motivation was fostered by changing attributions ($n = 5$; 13%), offering extrinsic motivators ($n = 3$; 8%), or emphasizing the value of reading ($n = 1$; 3%). Appendix 2 provides several examples of how these motivational mechanisms were applied in the interventions.

In approximately half of the interventions ($n = 23$; 58%), motivational support was complemented with skills instruction, such as teaching reading strategies or practicing fluent reading. In most interventions, narrative texts ($n = 8$; 20%), informational texts ($n = 12$; 30%), or both ($n = 16$; 40%) were used. In some interventions, only words or sentences were used for reading ($n = 4$; 10%). The interventions were delivered by either a researcher ($n = 13$; 33%) or someone else ($n = 26$; 65%), mostly teachers ($n = 23$) and in some cases preservice teachers ($n = 1$), volunteers ($n = 1$) or tutors with an undergraduate degree ($n = 1$). For one intervention, no information was provided about its provider. The total duration of the interventions varied strongly, ranging from less than half an hour to 195 h. Although some interventions consisted of only one session, other interventions were implemented two lessons a day for several months (maximum of 260 sessions).

Most interventions targeted primary school students ($n = 32$; 80%), whereas a much smaller number of interventions was directed at secondary school students ($n = 8$; 20%). Although most interventions focused on typical (i.e., heterogeneous groups of) readers ($n = 25$; 63%), a substantial number of the interventions targeted struggling readers ($n = 15$; 38%). The percentage of boys in the studies ranged from 35.42% to 75.00%.

Intervention Effects

To answer Research Question 1, we first analyzed the overall intervention effects on affirming reading motivations, extrinsic reading motivations, undermining reading motivations, combined motivations, and reading comprehension. The 39 studies in the meta-analysis included 55 experimental comparisons targeting affirming motivations, 12 targeting extrinsic motivations, eight targeting undermining motivations, five targeting combined motivations, and 39 targeting reading comprehension. The

interventions had small, significant positive effects on affirming motivations (Cohen's $d = 0.38$; $SE = 0.06$), extrinsic motivations (Cohen's $d = 0.42$; $SE = 0.16$), and reading comprehension (Cohen's $d = 0.27$; $SE = 0.05$), and a significant, but trivial effect on combined motivation scores (Cohen's $d = 0.17$; $SE = 0.04$). The mean effect on undermining motivations was not significant (Cohen's $d = -0.01$; $SE = 0.07$).

Subsequently, we compared effects on immediate and delayed post-tests. The time between the intervention and delayed post-test ranged from 2 to 28 weeks. Delayed post-test results were only reported for affirming motivations ($k = 5$), undermining motivations ($k = 2$), and reading comprehension ($k = 7$). For affirming motivations, a small effect was found on immediate post-tests (Cohen's $d = 0.40$; $SE = 0.07$) and a trivial effect on delayed post-tests (Cohen's $d = 0.19$; $SE = 0.13$). Effects on undermining motivations were neither significant on immediate post-tests (Cohen's $d = -0.07$, $SE = 0.08$) nor delayed post-tests (Cohen's $d = -0.03$, $SE = 0.15$). For reading comprehension, a small effect was found on immediate post-tests (Cohen's $d = 0.29$; $SE = 0.06$) and a trivial effect on delayed post-tests (Cohen's $d = 0.16$; $SE = 0.07$). Effects on immediate and delayed post-tests did not significantly differ for any of the outcomes (affirming motivations: $Q(1) = 2.00$, $p = .16$; undermining motivations: $Q(1) = 0.05$, $p = .83$; reading comprehension: $Q(1) = 1.99$, $p = 0.16$).

Moderator Analyses

To explain variability in effect sizes, we conducted moderator analyses based on intervention, sample, study, and measurement characteristics (Research Question 2). Moderator analyses were performed for immediate post-tests on affirming reading motivations and reading comprehension only, as few studies investigated effects on delayed post-tests and on extrinsic motivations, undermining motivations, and combined motivations. The outcomes of all moderator analyses are displayed in Table 2.

Intervention Characteristics

In the first series of moderator analyses, we analyzed the effects of intervention characteristics. Motivational mechanism was shown to influence program effects on reading motivation and reading comprehension. Interest was a significant positive moderator of affirming motivations and reading comprehension: interventions that triggered interest had larger effects on affirming motivations and reading comprehension than those that did not. No significant moderator effects were found for the other motivational mechanisms. We found no effect of the combination of motivation interventions with skills instruction: programs that focused solely on motivation were equally effective in stimulating affirming motivations and reading comprehension as programs that combined this with, for instance, reading strategy instruction. Furthermore, intervention effects were not moderated by the type of texts used in the interventions. Interventions using narrative texts, informational texts, or sentences/words for reading were equally effective in stimulating affirming motivations and reading comprehension. Provider of the intervention proved to be a significant moderator of reading comprehension, but not of affirming reading motivations:

Table 2 Moderator analyses of intervention, sample, study, and measurement characteristics

Categorical variables	Categories	$k_{\text{mot}}; k_{\text{comp}}$	Cohen's d (SE)		Q	
			Affirming motivation	Comprehension	Affirming motivation	Comprehension
Intervention characteristics Motivational mechanisms	Competence support					
	Yes	31; 21	0.39 (0.08)	0.33 (0.10)	$Q(1) = 0.07$	$Q(1) = 0.28$
	No	19; 11	0.43 (0.14)	0.26 (0.08)		
	Autonomy support					
	Yes	17; 11	0.55 (0.12)	0.34 (0.14)	$Q(1) = 3.72$	$Q(1) = 0.62$
	No	33; 21	0.28 (0.08)	0.22 (0.05)		
	Relatedness/social motivation					
	Yes	21; 13	0.49 (0.09)	0.37 (0.13)	$Q(1) = 1.71$	$Q(1) = 1.75$
	No	29; 19	0.31 (0.10)	0.19 (0.05)		
	Interest					
	Yes	29; 16	0.51 (0.10)	0.41 (0.12)	$Q(1) = 5.85^*$	$Q(1) = 4.75^*$
	No	21; 16	0.21 (0.08)	0.13 (0.04)		
	Extrinsic motivators					
	Yes	3; 0	-0.42 (0.56)	-	$Q(1) = 2.13$	-
	No	47; 32	0.43 (0.07)	-		
	Mastery goals					
	Yes	20; 16	0.43 (0.12)	0.33 (0.11)	$Q(1) = 0.28$	$Q(1) = 0.68$
	No	30; 16	0.36 (0.08)	0.22 (0.06)		
	Attributions					
	Yes	6; 3	0.30 (0.18)	0.15 (0.12)	$Q(1) = 0.30$	$Q(1) = 1.33$
	No	44; 29	0.41 (0.07)	0.31 (0.07)		
	Value of reading					
	Yes	1; 0	0.53 (0.27)	-	$Q(1) = 0.22$	-
	No	49; 32	0.40 (0.07)	-		

Table 2 (continued)

Categorical variables	Categories	k_{mot} ; k_{compr}	Cohen's d (SE)		Q	
			Affirming motivation	Comprehension	Affirming motivation	Comprehension
Skills instruction	Yes	31; 25	0.39 (0.07)	0.29 (0.07)	$Q(1) = 0.01$	$Q(1) = 0.01$
	No	19; 7	0.41 (0.17)	0.28 (0.12)		
Text genre	Narrative texts	8; 6	0.67 (0.22)	0.31 (0.12)	$Q(3) = 5.08$	$Q(3) = 2.87$
	Informational texts	18; 13	0.36 (0.12)	0.39 (0.15)		
	Narrative and informational texts	19; 11	0.27 (0.09)	0.17 (0.06)		
	Words and/or sentences	5; 2	0.75 (0.27)	0.14 (0.19)		
Provider	Researcher	14; 6	0.47 (0.19)	0.66 (0.17)	$Q(2) = 3.21$	$Q(2) = 6.78^*$
	Other	35; 25	0.39 (0.08)	0.24 (0.07)		
	Unknown	1; 1	0.14 (0.13)	0.13 (0.13)		
Sample characteristics						
Educational stage	Primary education	42; 24	0.38 (0.08)	0.36 (0.09)	$Q(1) = 0.44$	$Q(1) = 6.08^*$
	Secondary education	8; 8	0.50 (0.17)	0.12 (0.03)		
Reader level	Mainly typical readers	33; 20	0.37 (0.10)	0.36 (0.10)	$Q(1) = 0.03$	$Q(1) = 5.59^*$
	Mainly struggling readers	17; 12	0.40 (0.08)	0.12 (0.04)		
Study characteristics						
Design	Experimental design	17; 14	0.38 (0.15)	0.19 (0.05)	$Q(1) = 0.03$	$Q(1) = 1.59$
	Quasi-experimental design	33; 18	0.41 (0.08)	0.33 (0.10)		
Control group	Business-as-usual	38; 25	0.36 (0.06)	0.26 (0.06)	$Q(1) = 0.03$	$Q(1) = 0.63$
	Part of the intervention/other intervention	12; 7	0.40 (0.22)	0.44 (0.22)		
Measurement characteristics						

Table 2 (continued)

Categorical variables	Categories	$k_{\text{mot}}; k_{\text{compr}}$	Cohen's d (SE)		Q	
			Affirming motivation	Comprehension	Affirming motivation	Comprehension
Type of measurement	Test	0; 32	-	-	$Q(2) = 91.20^{***}$	-
	Observation	6; 0	0.31 (0.47)	-		
	Self-report	43; 0	0.36 (0.06)	-		
	Teacher report	1; 0	1.53 (0.11)	-		
Standardization	Study independent measure	36; 19	0.45 (0.07)	0.27 (0.08)	$Q(1) = 1.16$	$Q(1) = 0.11$
	Developed within the context of the study	14; 13	0.23 (0.18)	0.31 (0.10)		
Continuous variables			b (SE) affirming motivation			
Intervention characteristics			b (SE) reading comprehension			
Number of sessions		0.003 (0.002)		0.001 (0.001)		
Total duration of the intervention		0.004 (0.002)*		0.001 (0.001)		
Sample characteristics						
Percentage of boys		0.023 (0.011)*		-0.008 (0.010)		

Note. k = number of samples

* $p < .05$. ** $p < .01$. *** $p < .001$

interventions delivered by researchers had larger effects on reading comprehension than interventions delivered by others. The effects of the number of sessions and total duration were analyzed using meta-regression analysis. The number of sessions was not related to effects on affirming motivations and reading comprehension. The effect of total duration was significant for affirming motivations but not for reading comprehension. Effects on affirming motivations were larger if the total duration of the intervention was longer.

Sample Characteristics

In the second series of moderator analyses, we examined the effects of sample characteristics. Educational stage was a significant moderator of effects on reading comprehension; interventions involving primary schoolers were more effective than interventions involving secondary schoolers. Interventions involving primary and secondary schoolers were equally effective in promoting affirming reading motivations. Reading level proved to be a significant moderator of reading comprehension, but not of affirming motivations. The interventions had significantly larger effects on reading comprehension if the sample included mainly typical readers than if it included mainly struggling readers. The effect of the percentage of boys was analyzed using meta-regression analysis. The outcome was significant for affirming reading motivations, but not for reading comprehension. Effects on affirming reading motivations were larger if the share of boys in the sample was higher.

Study Characteristics

In the third series of moderator analyses, we analyzed the effects of two study characteristics: study design and type of control group. The moderator analyses did not reveal any significant effects of these variables.

Measurement Characteristics

In the fourth and final series of moderator analyses, we examined the effects of measurement characteristics. A significant effect of measurement type was found on affirming motivations, indicating that effects were largest for teacher reports, as compared to self-reports and observations. However, it should be noted that teacher reports were used in only one study. Reading comprehension was measured by tests in all studies, so no moderator analyses of measurement type on reading comprehension were conducted. Finally, effects on measurements developed within the context of the study and study-independent measures did not significantly differ.

Discussion

The objectives of this meta-analysis were to investigate the effects of theory-based reading motivation interventions in school on reading motivation and reading comprehension (Research Question 1) and to examine whether effects were moderated by

predefined intervention, sample, study, and measurement characteristics (Research Question 2). The results indicate that investing in reading motivation can positively affect students' reading motivation and reading comprehension. Effects on reading motivation were moderated by the motivational mechanism elicited in the intervention, the duration of the intervention, gender, and type of measurement. Interventions that aimed to trigger interest had the largest effects on affirming motivations. Furthermore, effects were larger if the total duration of the intervention was longer and if the share of boys in the sample was higher. Finally, larger effects on affirming motivations were found on teacher reports, as compared to self-reports and observations. Effects on reading comprehension were moderated by the motivational mechanism elicited in the intervention, the provider of the intervention, educational stage, and reading level. Interventions that aimed to trigger interest had the largest effects on reading comprehension. Furthermore, interventions delivered by researchers had larger effects than interventions delivered by others (mostly teachers). Effects on reading comprehension were significantly larger for primary schoolers than for secondary schoolers. Finally, effects were significantly larger for typical readers than for struggling readers.

The positive effects we found on reading motivation and reading comprehension largely correspond to the results of earlier meta-analyses (Guthrie et al., 2007; McBreen & Savage, 2020; Unrau et al., 2018). Comparable to previous meta-analyses, the effects we found were mostly small but significant, although for some categories of studies average effects could range up to medium; for instance, we found a medium effect on affirming motivations of programs that trigger interest. Our outcomes thus give further support to the assumption that reading motivation can be fostered by educational interventions and that, by promoting reading motivation, students' reading achievement can be increased. Apparently, increased motivation as an outcome of program participation results in students reading more frequently, which enables them to more effectively practice their reading comprehension skills. Students might then enter a process of reciprocal causation, where increased motivation and proficiency mutually influence each other, eventually leading to long-term benefits (Morgan & Fuchs, 2007; Stanovich, 1986). Our meta-analysis provides little ground for such long-term benefits, however: follow-up effects were significant, but trivial at best. Moreover, effects on delayed post-tests were included in a limited number of studies and the time between the intervention and delayed post-tests varied strongly. More research is thus needed to draw definite conclusions about long-term effects.

Effects on reading motivation appear to depend on the type of motivation. Significant positive effects were found on affirming and extrinsic motivations. Even though extrinsic motivations were hardly emphasized in the interventions, the effect on extrinsic motivations was as large as that on affirming motivations. This may be explained by previous observations of a positive relation between intrinsic and extrinsic motivation: studies by Schaffner et al. (2013) and Troyer et al. (2019) found that students with higher intrinsic motivation often have higher extrinsic motivation as well. For intervention effects, this implies that an increase in intrinsic motivation may be paralleled by an increase in extrinsic motivation. Particularly in a school context, enhanced enjoyment of reading may, for instance, go hand in hand with an enhanced sense of its importance for students' futures. The effect on undermining motivations was not significant, suggesting that current interventions are not sufficient to decrease

undermining motivations. Undermining motivations are thought to be the consequence of an accumulation of negative reading experiences throughout students' school careers and are thus likely to be persistent (Nielen et al., 2016). Guthrie et al. (2009) suggest that to decrease undermining motivations a strong structure of motivational support is necessary: a combination of various motivational mechanisms over an extended period of time may be needed to reduce undermining motivations. As only few studies examined effects on undermining motivations, additional research is needed to decide whether this assumption can be confirmed.

As we analyzed the effects of a range of reading motivation interventions, while at the same time limiting ourselves to theory-based interventions, the results provide new insights into which theory-driven motivational mechanisms are particularly effective. Moderator analyses suggest that interventions in which interest is triggered have the largest effect on affirming motivations and reading comprehension. This does not necessarily mean that other mechanisms (e.g., autonomy support or mastery goals) were ineffective. Since often multiple mechanisms were combined in one intervention, the moderator effect of interest signals that it matters whether interest is part of the package offered (for a similar interpretation, see Okkinga et al., 2018). Interest could thus be seen as one of the main determinants of a successful intervention. Providing students with reading materials that match their individual interests or devising reading activities that trigger situational interest might be seen as a precondition for motivation to arise.

Interventions with and without skills instruction were equally effective in improving reading motivation and reading comprehension. This outcome can be interpreted as indicative of the added value of motivational support for reading. The observation that motivation-only interventions yield similar effects as broad interventions do, suggests that positive intervention effects are not necessarily attributable to other elements of an intervention but can be pinpointed to motivational support. This makes our estimate of the effects of motivational support more precise than in, for instance, the previous meta-analysis by McBreen and Savage (2020). At the same time, it would be risky to conclude that motivational support alone is sufficient to raise students' level of reading comprehension. Although our moderator analysis shows that motivation-only interventions do have a positive effect on reading comprehension, such interventions are often an addition to the existing reading curriculum. Naturally, growth in reading comprehension is a consequence of regular reading education as well, although motivational support appears to strengthen this effect.

The moderator effect of gender is promising, as especially boys are often characterized by low reading motivation (Baker & Wigfield, 1999; Logan & Johnston, 2009; McKenna et al., 1995; Parson et al., 2018). Struggling readers also often have low reading motivation levels (McKenna et al., 1995; Toste et al., 2020; Vaknin-Nusbaum et al., 2018). The results of our meta-analysis indicate that reading motivation interventions are equally effective in fostering the reading motivation of struggling and typical readers. However, the effects of reading comprehension were smaller for struggling readers, suggesting that these students may need more instruction to improve their reading proficiency to the same extent as typical readers. Effects on reading comprehension were significantly larger for primary schoolers than for secondary schoolers; for the latter students, the effect was only marginal.

This may be explained by the fact that students in primary education usually make larger gains in reading skills than students in secondary education (Bloom et al., 2008). Therefore, smaller effects may be expected in secondary education. However, conclusions for secondary schoolers remain somewhat tentative, as only a small share of the interventions (20%) focused on these students. More research is needed to get more insight into effective reading promotion in secondary education.

Three other moderators had significant effects: provider of the intervention, total intervention duration, and type of measurement. Interventions delivered by researchers had larger effects on reading comprehension than interventions delivered by others (in most cases teachers), possibly because researchers paid more attention to implementing the intervention with levels of high fidelity than teachers (c.f., Edmonds et al., 2009; Okkinga et al., 2018). This result underlines the importance of thoroughly communicating program principles to those who are conducting interventions in the field (Durlak & DuPre, 2008). Effects on motivation were larger if the total duration of the intervention was longer, which indicates the importance of investing in students' reading motivation during a longer period of time. The largest effects on reading motivation were found on teacher reports. However, it should be noted that teacher reports were only used in one study, so no strong conclusion can be drawn from this outcome.

Other moderators (text genre, study design, type of control group, and whether instruments were developed within the context of the study or not) showed no significant effects. The fact that positive effects were observed in studies with a strong design and on study-independent measures as well further substantiates our conclusions that reading motivation interventions can positively influence students' reading motivation and reading comprehension.

Limitations and Future Research

When interpreting the results of this meta-analysis, some limitations should be considered. We examined the effects of theory-based motivational mechanisms on reading motivation and reading comprehension. In many interventions, a combination of these mechanisms was applied. The sample of studies in the meta-analysis was not large enough to test the effects of all combinations. Therefore, we tested whether interventions in which certain mechanisms were triggered had larger effects on reading motivation or reading comprehension than interventions in which these mechanisms were not triggered. Future studies may reveal whether certain combinations of motivational mechanisms are more effective than other combinations.

We aimed to identify which theoretical mechanisms contribute to the promotion of reading motivation and comprehension, thereby providing better insights into the effective ingredients of motivational interventions. Therefore, we only included theory-based interventions. Notwithstanding this strict inclusion criterion, we observed that, in several studies, the theoretical framework, the motivational mechanisms elicited, and the outcome variables did not always fully correspond. In future studies, researchers should thus be more precise in aligning the design of their interventions and the selection of measures with the theoretical model they choose to start from.

In conducting the moderator-analyses, we followed the analog-to-the-ANOVA procedure (Lipsey & Wilson, 2001), which is common practice in meta-analyses. However, some moderators likely overlap. For instance, interventions focusing on both motivation and skills instruction were often longer than interventions only focusing on motivation. Such confounding could be reduced by combining moderators in one analysis. However, such an analysis would require a larger set of studies than available in the present meta-analysis.

A limitation in many studies is that they did not examine treatment fidelity. Despite its importance in interpreting intervention effects (Durlak & DuPre, 2008), we found that slightly more than half of the studies reported on implementation. The moderator effect of provider of the intervention suggests that implementation quality was a factor in the interventions we examined. This outcome stresses the need for attention to monitoring program implementation in practice and research.

Conclusion and Implications

We conclude that there is an effect of motivational interventions on both reading motivation and reading comprehension. Our meta-analysis thereby contributes to the debate about the direction of the association between motivation and achievement (Aunola et al., 2002; Becker et al., 2010; Schiefele et al., 2016): our outcomes provide ground for the hypothesis that reading motivation affects reading proficiency, either independently or as part of a process of reciprocal causation. This, in turn, suggests that motivational support should be part of a model of reading instruction (Duke et al., 2011; Duke & Cartwright, 2021).

The results of our meta-analysis also provide information on what are the most effective ingredients of reading motivation interventions. Interventions that aimed to trigger students' interest had the largest effects on reading motivation and reading comprehension. This outcome can inform teachers who are committed to furthering their students' reading development, developers of educational methods, and those who make decisions about curricula for reading education. It seems particularly important to trigger students' interest, for example, by matching texts to students' reading levels or by making real-world connections.

At the same time, our meta-analysis provides an impetus for further research. We are in need of studies that examine whether positive effects are sustained over time. Furthermore, studies should take into account implementation quality and provide information on how to best support teachers in implementing motivational mechanisms. Finally, future studies should not only examine how to promote affirming motivations but also to decrease undermining motivations.

Appendix 1

Bibliographic information, intervention, sample, study, and measurement characteristics and effect sizes

Intervention characteristics

No.	Author 1 + year	Intervention name	Theoretical basis	Motivational mechanisms	Skills instruction	Text type	Provider	Number of sessions	Duration in hours
1	Aarnoutse 2003	-	REM	Int. aut, soc	Yes	Inf	Other	40	?
2	Andreassen 2011	ERCI	REM	Int. aut	Yes	Inf	Other	90	67.5
3	Bates 2016	RR	EVT, REM	Int. soc, comp	Yes	Nar	Other	80	40
4a	Bråten 2017	-	REM	Int	No	Inf	Researcher	1	0.28
4b	-	-	REM	Int	No	Inf	Researcher	1	0.28
5a	Cantrell 2016	LSC	REM	Comp	Yes	Both	Other	200	183.33
5b	-	-	-	-	-	-	-	-	-
6	Cantrell 2014	LSC	REM	Comp	Yes	Both	Other	?	166.67
7	Cuevas 2012	ISR	IT	Int	Yes	Both	Other	14	14
8	Förster 2014	LPA+G	SDT	Comp, goa, att	No	Both	Other	8	?
9a	Fowler 1981	-	AT	Att	No	W/S	Researcher	3	?
9b	-	-	AT	Att	No	W/S	Researcher	3	?
10a	Guthrie 2004	CORI	REM	Int. aut, soc, comp, goa	Yes	Inf	Other	60	90
10b	-	CORI	REM	Int. aut, soc, comp, goa	Yes	Inf	Other	60	90

No.	Author 1 + year	Intervention name	Theoretical basis	Motivational mechanisms	Skills instruction	Text type	Provider	Number of sessions	Duration in hours
11	Guthrie 2000	CORI	REM	Int, aut, soc, comp, goa	Yes	Inf	Other	85	127.5
12a	Hautula 2022	RT-P	SCT	Comp	Yes	Nar	Other	8	12
12b									
12c		RT-G	SCT	Comp, goa	Yes	Nar	Other	8	12
12d									
13	Kao 2016	-	EVT	Int, comp	No	Nar	Researcher	1	0.5
14	Kim 2020	MORE	IT, REM	Int, aut, soc, comp, goa	Yes	Inf	Other	10	10
15	Kurnaz 2020	PBASA	IT	Int	No	Both	Other	?	?
16a	Law 2011	-	AGT, SDT	Int, aut, soc, goa	Yes	Nar	Other	5	5
16b									
16c		-	AGT, SDT	Int, aut, soc, goa	Yes	Nar	Other	5	5
16d									
17	Lee 2014	PALS	REM	Soc, comp	Yes	Nar	Other	32	10.67
18a	Levinson 2017	-	IT	Int, comp	No	Both	Other	10	2.5
18b									
18c									
18d									
19	Marinak 2013	CRI	EVT	Int, aut, soc, comp	No	Both	Other	?	?
20a	Marinak 2008	-	SDT	Ext	No	Both	Researcher	1	?
20b		-	SDT	Ext	No	Both	Researcher	1	?
20c		-	SDT	Ext	No	Both	Researcher	1	?

No.	Author 1 + year	Intervention name	Theoretical basis	Motivational mechanisms	Skills instruction	Text type	Provider	Number of sessions	Duration in hours
21a	Monteiro 2013	PRP	REM	Int, aut, soc, comp, goa	Yes	Both	Researcher	24	12
21b									
22	Nevo 2020	-	REM	Int, aut, soc	Yes	Both	Other	260	195
23a	Ng 2013	-	AGT	Soc, comp, goa	Yes	Inf	Other	8	7
23b									
24	Schaffner 2007	-	SDT	Int, goa	No	Inf	?	1	0.75
25a	Schunk 1991	-	SCT, AGT	Comp, goa	Yes	Inf	Researcher	15	8.75
25b		-	SCT, AGT	Comp, goa	Yes	Inf	Researcher	15	8.75
26a	Shelton 1985	-	AT	Att	No	W/S	Researcher	6	3
26b									
27a	Souvignier 2006	BTD	AGT	Goa, att	Yes	Both	Other	20	15
27b									
27c									
28	Taboada 2013	-	REM	Aut	Yes	Inf	Other	171	?
29	Taboada 2018	USHER	REM	Int, soc, comp	Yes	Inf	Other	25	18.75
30a	Taboada 2015	USHER	REM	Int, soc, comp	Yes	Inf	Other	35	52.50
30b									
31	Thames 1994	-	IT	Int, val	Yes	Both	Other	24	20
32	Toste 2017	MWR+MB	SCT	Comp	Yes	W/S	Other	24	16
33	Toste 2019	MWR+MB	SCT	Comp, goa	Yes	W/S	Other	40	26.67
34	Turan 2018	-	EVT	Int	No	Nar	Other	12	12

No.	Author 1 + year	Intervention name	Theoretical basis	Motivational mechanisms	Skills instruction	Text type	Provider	Number of sessions	Duration in hours
35a	Villiger 2012	LiFus	IT, SDT	Int. aut, soc, comp	No	Both	Other		46.67
35b									
36	Wigfield 2008	CORI	REM	Int. aut, soc, comp, goa	Yes	Inf	Other	60	90
37	Wigfield 2004	CORI	REM	Int. aut, soc, comp, goa	Yes	Inf	Other	60	105
38	Wolters 2017	-	SCT, AGT	Comp. goa	No	Both	Researcher	1	?
39	Wu 2021	-	SDT	Aut, soc, comp	Yes	Both	Other	18	12

Intervention names: *ERCI* = explicit reading comprehension instruction, *RR* = reading recovery, *LSC* learning strategies curriculum, *ISR* = independent silent reading, *LPA+G* = learning progress assessment with goal setting, *CORI* = concept-oriented reading instruction, *RT-P* = readers' theater practice; *RT-G* = readers' theater goal; *MORE* = model of reading engagement; *PBASA* = personalized book advice smart application; *PALS* = peer assisted learning strategies, *CRI* = courageous reading instruction, *PRP* = paired reading program, *BTD* = becoming a text detective, *USHER* = United States history for engaged reading, *MWR+MB* = multisyllabic word reading with motivational beliefs, *LiFus* = Lesen in Familie und Schule. Theoretical basis: *REM* = reading engagement model, *EVT* = expectancy value theory, *IT* = interest theory, *SDT* = self-determination theory, *AT* = attribution theory, *AGT* = achievement goal theory, *SCT* = social cognitive theory. Motivational mechanisms: *int* = interesse, *aut* = autonomy, *soc* = social motivation, *comp* = (perceived) competence, *goa* = (mastery) goals, *att* = attributions, *ext* = extrinsic motivators, *val* = value of reading. Text type: *inf* = informational, *nar* = narrative, *W/S* = words/sentences

Sample characteristics

No.	Author 1 + year	Educational stage	Struggling readers	% boys	N experimental condition; N control condition
1	Aarnoutse 2003	Primary	No	?	155; 172
2	Andreassen 2011	Primary	No	45	103; 113
3	Bates 2016	Primary	Yes	60	1334; 472
4a	Bråten 2017	Primary	No	46	44; 42
4b		Primary	No	46	44; 42
5a	Cantrell 2016	Secondary	Yes	59	605; 530
5b		Secondary	Yes	57	593; 535
6	Cantrell 2014	Secondary	Yes	58	523; 481
7	Cuevas 2012	Secondary	No	54	30; 70
8	Förster 2014	Primary	No	50	280; 285
9a	Fowler 1981	Primary	Yes	57	7; 7
9b		Primary	Yes	57	7; 7
10a	Guthrie 2004	Primary	No	48	148; 213
10b		Primary	No	53	195; 260
11	Guthrie 2000	Primary	No	53	79; 83
12a	Hautala 2022	Primary	Yes	42	49; 59
12b					
12c		Primary	Yes	45	50; 59
12d					
13	Kao 2016	Primary	No	?	20; 20
14	Kim 2020	Primary	No	49	450; 224

No.	Author 1 + year	Educational stage	Struggling readers	% boys	N experimental condition; N control condition
15	Kurnaz 2020	Secondary	No	51	300; 285
16a	Law 2011	Primary	No	48	94; 86
16b					
16c		Primary	No	52	99; 86
16d					
17	Lee 2014	Primary	No	45	53; 52
18a	Levinson 2017	Primary	No	35	6; 5
18b		Primary	No	35	6; 7
18c		Primary	No	35	5; 5
18d		Primary	No	35	5; 6
19	Marinak 2013	Primary	No	57	32; 44
20a	Marinak 2008	Primary	No	?	15; 15
20b		Primary	No	?	15; 15
20c		Primary	No	?	15; 15
21a	Monteiro 2013	Primary	Yes	?	40; 40
21b		Primary	Yes	?	40; 40
22	Nevo 2020	Primary	No	40	29; 29
23a	Ng 2013	Primary	Yes	53	25; 25
23b					
24	Schaffner 2007	Secondary	No	45	125; 125
25a	Schunk 1991	Primary	Yes	53	10; 10
25b		Primary	Yes	53	10; 10
26a	Shelton 1985	Primary	Yes	75	16; 16
26b					

No.	Author 1 + year	Educational stage	Struggling readers	% boys	N experimental condition; N control condition
27a	Souvignier 2006	Primary	No	50	95; 263
27b					95; 84
27c		Primary	No	50	115; 84
28	Taboada 2013	Primary	No	52	69; 50
29	Taboada 2018	Secondary	No	60	103; 100
30a	Taboada 2015	Secondary	No	51	378; 133
30b		Secondary	No	51	106; 154
31	Thames 1994	Primary	Yes	50	29; 29
32	Toste 2017	Primary	Yes	49	19; 22
33	Toste 2019	Primary	Yes	47	38; 7
34	Turan 2018	Secondary	No	?	36; 36
35a	Villiger 2012	Primary	No	48	244; 244
35b					
36	Wigfield 2008	Primary	No	?	164; 164
37	Wigfield 2004	Primary	No	?	150; 200
38	Wolters 2017	Secondary	Yes	47	30; 30
39	Wu 2021	Secondary	Yes	56	168; 174

Study characteristics and characteristics of the outcome measures

No.	Author 1 + year	Design	Control group type	Measurement type	Developed within context of the study	Measurement time; number of weeks	ES motivation aff; extr; und; comb	ES reading comprehension
1	Aarnoutse 2003	Quasi-exp.	Bau	Sr + test	Both	Direct	0.17; -; -; -	0.03
2	Andreassen 2011	Quasi-exp.	Bau	Sr + test	Both	Direct	0.01; -0.15; -; -	-0.16
3	Bates 2016	Quasi-exp.	Bau	Sr	No	Direct	0.30; -; -; -	-
4a	Bråten 2017	Exp.	Bau	Sr + test	Yes	Direct	0.10; -; -; -	0.62
4b							-0.07; -; -; -	0.61
5a	Cantrell 2016	Exp.	Bau	Sr + test	No	Direct	-; -; -; 0.13	0.15
5b							-; -; -; 0.19	0.10
6	Cantrell 2014	Exp.	Bau	Sr + test	No	Direct	0.23; 0.26; -; 0.15	0.04
7	Cuevas 2012	Exp.	Bau	Sr + test	No	Direct	-; -; -; 0.62	0.62
8	Förster 2014	Quasi-exp.	Bau	Sr + test	No	Direct	-0.16; 0.03; -; -	-0.02
9a	Fowler 1981	Quasi-exp.	Bau	Obs	No	Direct	0.58; -; -; -	-
9b							0.84; -; -; -	-
10a	Guthrie 2004	Quasi-exp.	Int.	Sr + test	Both	Direct	0.96; -; -; -	-0.16
10b		Quasi-exp.	Int.	Tr + test	Both	Direct	1.53; 1.51; -; -	0.71
11	Guthrie 2000	Quasi-exp.	Bau	Sr	No	Direct	0.96; 0.27; -; -	-
12a	Hautala 2022	Exp.	Int.	Sr + test	Yes	Direct	0.00; -; -0.31; -	0.05
12b						Delayed; 28	0.09; -; 0.00; -	-0.05
12c						Direct	-0.18; -; -0.05; -	0.05
12d						Delayed; 28	-0.07; -; -0.06; -	0.11
13	Kao 2016	Quasi-exp.	Int.	Sr + test	Both	Direct	1.31; -; -; -	1.19
14	Kim 2020	Quasi-exp.	Bau	Sr + tr + test	No	Direct	0.30; -; -; -	-0.09
15	Kurnaz 2020	Exp.	Bau	Sr	No	Direct	-; -; -; 0.18	-

No.	Author 1 + year	Design	Control group type	Measurement type	Developed within context of the study	Measurement time; number of weeks	ES motivation aff; extr; und; comb	ES reading comprehension
16a	Law 2011	Quasi-exp.	Bau	Sr + test	Both	Direct	0.30; 0.32; 0.05; -	0.45
16b				Test	Yes	Delayed; 13	- ; - ; - ; -	0.23
16c				Sr + test	Both	Direct	0.37; 0.13; -0.08; -	0.14
16d				Test	Yes	Delayed; 13	- ; - ; - ; -	0.24
17	Lee 2014	Quasi-exp.	Bau	Sr + test	No	Direct	0.37; - ; - ; -	0.38
18a	Levinson 2017	Quasi-exp.	Int.	Sr	No	Direct	0.06; - ; - ; -	-
18b							-0.11; - ; - ; -	-
18c							-1.14; - ; - ; -	-
18d							-0.01; - ; - ; -	-
19	Marinak 2013	Quasi-exp.	Bau	Sr	No	Direct	0.59; - ; - ; -	-
20a	Marinak 2008	Exp.	Bau	Obs	Yes	Direct	0.47; - ; - ; -	-
20b							-0.18; - ; - ; -	-
20c							-1.59; - ; - ; -	-
21a	Monteiro 2013	Quasi-exp.	Bau	Sr	No	Direct	0.53; 0.86; - ; -	-
21b				Sr			1.18; 0.15; - ; -	-
22	Nevo 2020	Quasi-exp.	Bau	Sr + test	No	Direct	1.32; - ; - ; -	1.39
23a	Ng 2013	Quasi-exp.	Bau	Sr + test	Both	Direct	0.28; 0.21; -0.05; -	0.50
23b				Sr + test	No	Delayed; 4	- ; - ; - ; -	0.77
24	Schaffner 2007	Exp.	Bau	Sr + test	Yes	Direct	0.14; - ; - ; -	0.13
25a	Schunk 1991	Exp.	Int.	Sr + test	No	Direct	-0.17; - ; - ; -	0.37
25b							1.00; - ; - ; -	1.47
26a	Shelton 1985	Exp.	Bau	Obs	Yes	Direct	1.69; - ; - ; -	-
26b				Obs	Yes	Delayed; 2	0.92; - ; - ; -	-
27a	Souvignier 2006	Quasi-exp.	Bau	Sr + test	No	Direct	-0.02; - ; - ; -	0.10

No.	Author 1 + year	Design	Control group type	Measurement type	Developed within context of the study	Measurement time; number of weeks	ES motivation aff; extr; und; comb	ES reading comprehension
27b				Sr + test	No	Delayed; 22	0.42; - ; - ; -	0.20
27c				Sr + test	No	Direct	0.19; - ; - ; -	0.42
28	Taboada 2013	Quasi-exp.	Bau	Sr	No	Direct	0.20; - ; - ; -	-
29	Taboada 2018	Quasi-exp.	Bau	Sr + test	Both	Direct	0.02; - ; - ; -	0.15
30a	Taboada 2015	Quasi-exp.	Bau	Sr	Yes	Direct	0.14; - ; - ; -	-
30b				Sr			0.12; - ; - ; -	-
31	Thames 1994	Exp.	Bau	Sr	Yes	Direct	0.53; - ; - ; -	-
32	Tostie 2017	Quasi-exp.	Bau	Sr + test	No	Direct	0.65; - ; - ; -	0.08
33	Tostie 2019	Exp.	Bau	Sr + test	No	Direct	0.21; - ; - ; -	0.18
34	Turan 2018	Quasi-exp.	Bau	Sr	No	Direct	3.91; - ; - ; -	-
35a	Villiger 2012	Quasi-exp.	Bau	Sr + test	No	Direct	0.09; - ; - ; -	-0.01
35b				Sr + test		Delayed; 22	0.00; - ; - ; -	0.06
36	Wigfield 2008	Quasi-exp.	Bau	Sr + tr + test	Both	Direct	0.52; - ; - ; -	1.55
37	Wigfield 2004	Quasi-exp.	Int.	Sr	No	Direct	0.27; - ; - ; -	-
38	Wolters 2017	Exp.	Bau	Sr + test	No	Direct	0.52; 0.42; -0.03; -	0.15
39	Wu 2021	Exp.	Bau	Sr + test	Both	Direct	0.32; 0.96; - ; -	0.17

Design: *exp* = experimental, *quasi-exp* = quasi-experimental. Control group type: *bau* = business as usual, *int* = (part of) an intervention. Measurement type: *sr* = self-report, *tr* = teacher report, *obs* = observation. ES motivation: *aff* = affirming, *extr* = extrinsic, *und* = undermining, *comb* = combined

Appendix 2

Examples of motivational mechanisms in the interventions

Motivational mechanism	Examples of how the motivational mechanisms are applied in interventions
Interest	• Recommending books related to students' interests (Kurnaz et al., 2020) • Hands-on activities such as dissecting an owl pallet before reading a text about owls (Guthrie et al., 2004)
Autonomy	• Choosing a text to read or generating questions to be answered after reading a text (Villiger et al., 2012) • Providing meaningful choices, for example of chapters to read or topics to write about (Taboada & Buehl, 2013)
Relatedness	• Cooperative learning in which students are responsible for their own learning and the results of the group (Villiger et al., 2012) • Shared reading with peers (Lee, 2014)
Competence	• Practicing a text so students are able to read it fluently (Villiger et al., 2012) • Teaching students to evaluate their progress in reading (Taboada et al., 2018)
Mastery goals	• Specifying goals for students to improve their own performance (Wolters et al., 2017) • Emphasizing what students can learn from a text and providing them opportunities to show that they understand the topic of a text (Law, 2011).
Attributions	• Reflecting on the origin of success so students will understand that putting effort into a task is worthwhile (Souvignier & Mokhesgerami, 2006)
Value of reading	• Emphasizing the importance of reading by stressing how listening, speaking, reading, and writing are related (Thames & Reeves, 1994)
Extrinsic motivators	• Providing rewards to students, for example, books (Marinak & Gambrell, 2008)

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10648-023-09719-3>.

Acknowledgments We would like to thank Wichor Bramer for his help with designing and conducting the literature search.

Funding This work was supported by the Netherlands Initiative for Education Research (NRO; grant number 405-15-717).

Declarations

Competing Interests The authors declare no competing interests.

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