The mediating effects of reading amount and strategy use in the relationship between intrinsic reading motivation and comprehension: differences between Grade 4 and Grade 6 students

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Abstract

There has been a significant volume of research studying the effect of individuals' motivation on reading comprehension. The findings of previous research have demonstrated both the direct contribution of motivation to comprehension and its indirect influence through mediating effects of reading amount and strategy use. The effect of the linkage between the two mediators, however, is somewhat underexplored in previous studies, meaning that we have not yet achieved a comprehensive understanding of the functioning of these mechanisms and especially the part reading amount and strategy use play in connecting reading motivation and comprehension. Also, it is still unclear whether the mechanisms governing this connection vary across different primary school grades. In light of these concerns, this study was conducted with 537 students from six primary schools in Hong Kong, including 266 Grade 4 and 271 Grade 6 students. All participants completed a reading comprehension task and a questionnaire survey. The results suggest that strategy use uniquely mediates the relationship between reading motivation and reading comprehension. No significant mediating effect through reading amount was found among either Grade 4 or Grade 6 children. However, for Grade 4 children alone, we discovered a two-stage mediating effect linking motivation and comprehension via (1) reading amount and (2) strategy use (i.e., reading motivation→reading amount→strategy use→reading comprehension). The findings from this study enrich our theoretical understanding the effects of reading motivation on reading comprehension and aslo provide pedagogical implications for directions in future reading instruction.

Keywords Reading motivation · Reading amount · Strategy use · Reading comprehension · Mediating effect

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Introduction

The development of reading skills is critical for individuals' academic success, both in the short and long term (Bastug, 2014; Suk, 2017). Students are expected to become engaged readers who are motivated to read extensively and strategically, and consequently enhance their literacy skills (Guthrie et al., 1999; Baker & Wigfield, 1999; Campbell et al., 1997; Marks, 2000; OECD, 2010). Reading engagement is commonly conceptualized as involving three components, namely behavioral engagement (i.e., amount of students' reading), affective engagement (i.e., intrinsic motivation for reading), and cognitive engagement (i.e., use of reading strategies) (Lee et al., 2021; McElhone, 2012). A large body of research has demonstrated that each component could be an important predictor of reading comprehension (see recent reviews on the effect of each engagement component—for reading motivation: Toste et al., 2020; for strategy use: Frid, & Friesen, 2019; for reading amount: van Bergen et al., 2020). Moreover, studies into reading engagement have also argued that these components not only contribute to reading comprehension individually but also interplay with each other to support the development of reading literacy (Guthrie & Klauda, 2014; Unrau & Quirk, 2014). In particular, reading motivation is usually viewed as an energizer driving children's reading amount and strategy use, thereby leading to a better understanding of the texts they read (Taboada et al., 2009). In other words, reading amount and strategy use are thought to function as mediators in the relationship between reading motivation and comprehension (Guthrie et al., 2012; Miyamoto et al., 2019; Stutz et al., 2016).

However, very little research that has taken into account the relationship between the two mediators of reading amount and strategy use. More importantly, it remains unclear whether such effects vary across different academic levels (i.e., between grades) among primary school students in different cultural contexts. This is a question that seems of particular significance for those students who are at the stage of progressing from "learning to read" to "reading to learn" (typically in Grade 4) and for those who educate them (Chall, 1996), as it could help us more thoroughly understand the relationship between reading engagement and comprehension. Hence, the present study, contextualized in Hong Kong, aims to extend the bounds of previous research by examining the mechanisms underlying reading motivation's contribution to reading amount, reading strategy and comprehension, and by investigating differences between Grade 4 and Grade 6 students.
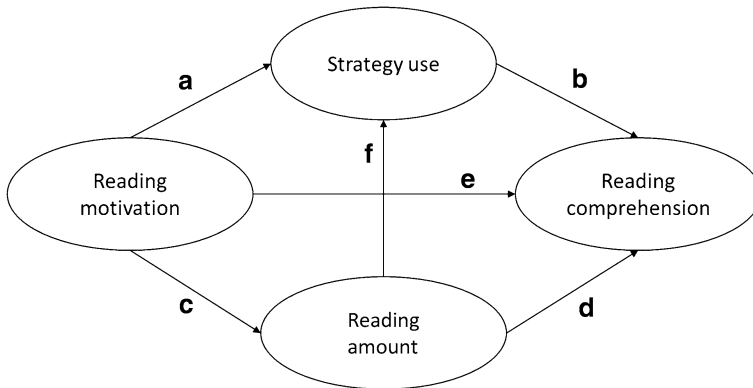
Fig. 1 Hypothesised model of indirect effects of reading motivation on reading comprehension

Literature review

Reading motivation and reading comprehension

Reading motivation is defined as *the relatively enduring readiness of a person to initiate reading activities* (Schaffner et al. 2013; Wigfield & Guthrie, 1997). Theoretically, in most of the literature, reading motivation can be classified into intrinsic and extrinsic dimensions (Schiefele et al., 2012; Stutz et al., 2016; Wigfield & Guthrie, 1997). Extrinsic reading motivation refers to external reasons for reading (e.g., to get recognition from others or win a prize in school), whereas intrinsic reading motivation is defined as the willingness to read for its own sake to experience pleasure and satisfaction (Dörnyei & Ushioda, 2011; Ryan & Deci, 2000; Schunk et al., 2008). Previous studies have demonstrated that intrinsic motivation could positively predict reading comprehension even when prior reading performance or socio-economic status are controlled (Logan et al., 2011; Retelsdorf et al., 2011), whereas extrinsic motivation may even undermine intrinsic motivation's effect on comprehension (e.g., Guthrie et al., 1999; Cox & Guthrie, 2001; Law, 2011; Schiefele & Löweke, 2017; Troyer et al., 2019; Wang & Guthrie, 2004). Therefore, this study mainly centers on the intrinsic motivation to read and its effects on comprehension. Given that the construct of intrinsic motivation is still inconclusive, we thus referred to the influential framework proposed by Baker and Wigfield (1999) and focused on three important aspects of intrinsic motivation, including *interest* (the desire to read about a particular topic of interest), *involvement* (the enjoyment experienced from reading) and the *importance* (subjective task values) of reading activities.

The mediating effects of reading amount and strategy use in the relationship between reading motivation and comprehension

In addition to the direct effect of reading motivation, research has investigated to varying extents its indirect effects on comprehension through the mediation of reading amount or strategy use. To better depict the relationships between these variables, we established a conceptual model as shown in Fig. 1.

For the mediating effect of reading strategies (*path a-b*, i.e., *reading motivation → strategy use → reading comprehension)*, it has been evident that the more intrinsically motivated students tended not only to use more strategies (Pardo, 2004) but also to use higher-level reading strategies (e.g., integrating text contents with elaborations) (McDaniel et al., 2000; Naceur & Schiefele, 2005), since they have a stronger intention and desire to understand the meaning of texts via deep-level text processing than less-interested students who were more inclined to process and store verbatim text features (Meece et al., 1988; Nolen & Haladyna, 1990; Schiefele, 1990). With the increased use of strategies, it is thought that students may gain better comprehension (Muijselaar et al., 2017; Samuelstuen & Bråten, 2005). A recent study by Völlinger et al. (2018), based on large-scale data from 1,105 German students in Grade 5, found a significant indirect effect of intrinsic reading motivation on reading comprehension through the use of reading strategy (questioning, summarizing, and predicting). However, among Chinese students in Grades 7-9, Wang et al. (2020) failed to find such a significant indirect effect of intrinsic motivation (i.e., curiosity, involvement, and challenge) on reading achievement through strategy use.

It has also been argued that reading amount plays a mediating role in the relationship between reading motivation and comprehension (*path c-d,* i.e., *reading motivation → reading amount → reading comprehension*) (Becker et al., 2010; Schaffner & Schiefele, 2016; Stutz et al., 2016). Motivated readers, it is claimed, tend to spend greater amounts of time and energy engaged in reading. They thus become more automatized in word decoding and acquire more vocabulary and topic knowledge, which in turn results in their expeditious and coherent comprehension of reading materials (e.g., El-Khechen et al., 2016; Guthrie et al., 1999, 2012). However, although several studies conducted among German primary students provided strong support for this argument (Becker et al., 2010; Miyamoto et al., 2019; Schaffner & Schiefele, 2016; Stutz et al., 2016), others have found that reading amount is not significant in mediating the relationship between reading motivation and comprehension among Taiwanese students in Grade 4 (Wang & Guthrie, 2004), U.S. students in Grades 3–5 (Troyer et al., 2019), and Chinese secondary students (Wang et al., 2020).

Taken together, the findings on the indirect effect of reading motivation with two mediators (i.e., strategy use and reading amount) are not consistent. In explaining their failure to replicate (among more than 4000 U.S. primary students) the Germany researchers' results of a significant mediating effect on reading amount, Troyer et al. (2019) argued that such mediating effects could be context-specific because students' background characteristics can differ significantly across studies. As Chiu and Chow (2010) suggested, the effect of reading motivation on reading achievement

was affected by cultural factors (cultural values, cultural capital, and cultural communication). Indeed, the educational emphasis and cultural values of the context in which research is conducted could influence the mediating roles of strategy use and reading amount. For instance, Guthrie and McRae (2012) found that the effect of behavioural engagement (e.g., amount of time spent reading) on comprehension was stronger for African Americans than for European Americans, which suggested that the effects of literacy practices on comprehension could differ in different cultural communities. Miyamoto et al. (2018) further found that reading amount could serve as a significant mediator among native German students but not among immigrant students whose parents hold higher expectations for their children' education. Considering that previous studies regarding these mediating effects were mostly conducted in western countries (e.g., Germany and the US), fewer have been done among Chinese students in primary schools. Wang and Guthrie (2004) explored the mediating effect of reading amount among Taiwanese primary students, but their study was focused on one mediator only, and their findings may not be applicable in other Chinese educational contexts such as Hong Kong due to differences in educational emphases and cultures in these two areas. Therefore, aiming to achieve a more comprehensive understanding, this present study is set out to examine in a Chinese learning context if both strategy use and reading amount could still act as mediators in the relationship between intrinsic motivation and reading comprehension.

Potential sequential mediating effects of reading amount and strategy use in the relationship between reading motivation and comprehension

Despite the large amount of research in this area, there has been very little exploration of the the possible association between the two mediators, namely reading amount and strategy use. In practice, the two mediators usually function together to affect reading comprehension, and so it would be useful to incorporate this relationship into explanations of the mechanism linking reading motivation and comprehension. As shown in Fig. 1, based on the literature review, we propose that there may exist a sequential two-stage mediating effect; that is, reading motivation first has impacts on reading amount (mediator 1), then strategic competence (mediator 2), and finally influences students' reading performance (*path c-f-b*).

This hypothesis was primarily grounded on two major arguments. The first was that intrinsically motivated students could be more strategically competent as a result of extensive reading. The more students have read, the more strategies they can employ during reading practice, such as identifying the main idea or drawing conclusions (Guthrie et al., 1996, 1999). Students who are exposed to more reading materials become increasingly self-regulated and more capable of coordinating a wide range of reading strategies (Schnotz et al., 2017). The effect of strategy training does not last long in the absence of sustainable reading opportunities during which students are able to exercise the strategies they have learned (Brown et al., 1996; Pressley, 2006).

The second argument underlying our hypothesis is that students increase their disciplinary and linguistic knowledge (e.g., their knowledge of genres) through a large

amount of reading, which would have the effect of further supporting students' use of reading strategies. Williams et al. (2005) demonstrated the effect of prior knowledge on strategy use with the example of Grade 1 students' incompetence in using a newly-learned strategy (i.e., compare-contrast) while reading expository texts that were organized in a way that students had not previously encountered. Furthermore, the effect of topic knowledge on strategy use has also been demonstrated in the circumstances of subject learning. For instance, examining college students' approach to learning a science topic, Taub et al. (2014) found that while prior knowledge did not differentiate undergraduates' cognitive strategies, students with well-developed prior knowledge about the topic were better able to employ meta-cognitive strategies (such as determining the importance of strategies).

Difference in the effect of intrinsic motivation on comprehension across grades

A further question raised here is whether motivation's direct and indirect effects via the two mediators on comprehension as outlined above change across different grades. The answer to this question could offer us a more in-depth understanding of this topic.

Presumably, as students advance to higher grades, they develop stronger reading abilities and accumulate more experience and knowledge through reading (Fox, 2009). Particularly from Grade 4, a critical point at which students transit from "learning to read" to "reading to learn", students usually have to read a large number of texts with sustainable motivation and a variety of strategies to expand their knowledge base to achieve academic success (Juel, 2006; Vellutino et al., 2007).

Along with these changes, though the findings are inconclusive, it seems the level of students' reading motivation and its relationship with reading comprehension vary as students progress through the grades. Although a significant amount of research has brought up the decline of intrinsic motivation in reading as students progress to higher grades (e.g., Lepper et al., 2005; Schaffner et al., 2016; Vaknin-Nusbaum et al., 2018), Wolters, et al. (2014) and Lau and Ho (2016) noted that students' reading motivation did not necessarily decrease in this way. Furthermore, studies have indicated that intrinsic motivation could be more critical for students in higher grades. García (2018) systematically reviewed related studies and argued that the predictive power of intrinsic motivation on reading was more significant among older students, particularly those in the upper elementary and middle grades. Saarnio et al. (1990) found that students' value, intrinsic motivation, and self-efficacy could significantly predict comprehension performance among good readers in Grade 5 but not among students in Grade 3. Similarly, Sideridis et al.'s (2006) examination of students from Grades 2–4 indicated that the motivational variables (efficacy and curiosity) became stronger predictors of reading comprehension as students get older.

Meanwhile, the relationships of the two mediators (i.e., strategy use and reading amount) with comprehension could vary. For instance, Kolić-Vehovec and Bajšanski (2006) conducted a study among Croatian students (N = 526) from Grades 5 to 8 and suggested that the correlations between text comprehension and reading strategies

(e.g., inference generation) were not significant until Grade 8. Locher and Pfost (2020) examined the effect of leisure time reading on reading comprehension among three cohorts of students (i.e., Grade 5, Grade 9, and college students) and found that while the effects in Grades 5 and 9 were similar and stable, they unexpectedly decreased among the college students. These studies generally seem to indicate that the importance of strategy use and reading amount could be increasingly contrasting, which further leads us to wonder if motivation's indirect effects on comprehension via these two mediators are similar in different grades.

To date, only a few studies have compared the mediating effects of strategy use and reading amount in the relationship between motivation and comprehension across grades. Chan (1994) found that strategy use could mediate the effects of motivational variables (i.e., belief in personal control, learned helplessness, perceived competence) on reading achievement in Grade 9 only, rather than in Grades 5 and 7. Miyamoto et al. (2019) recently suggested that these mediating mechanisms could differ among students with low and high ability in Grades 5 to 7. For the high-ability students, only the mediating effect of reading amount in the relationship between intrinsic motivation and comprehension was significant, while strategy use was the only significant mediator for the low-ability students. If Miyamoto et al.'s (2019) findings could also apply to students of different grades, their findings seem to contradict those of Chan (1994).

Based on the results of the above literature review, we assumed that a grade difference would exist in the relationships among the three engagement components and reading comprehension, particularly the different indirect effect of motivation on reading via reading amount and strategy use. It would thus be very meaningful to verify our hypothesis by examining grade differences in the mediating effects of reading amount and strategy use between Grade 4 and Grade 6 students in Hong Kong.

Research context

The present study was undertaken in Hong Kong. The issue of reading motivation among primary students in Hong Kong has attracted significant attention from educators. Although its students attained high rankings in PIRLS 2016 (e.g., coming third out of 61 participating countries/regions), Hong Kong students' reported reading motivation was not satisfactory because they only ranked 33rd in reading interest, 41st in reading confidence and 50th in engagement in the reading class among 50 countries or regions (Mullis et al., 2017). This incongruity between Chinese students' high achievement and low engagement has been called a "paradox" by some scholars (Watkins & Biggs, 2001).

This situation could be related to several cultural, historical, and educational factors. In contrast to the West's individual-oriented culture (the context within which most previous studies in this area have been conducted), Hong Kong's Confucianism-oriented culture encourages students to practice reading out of extrinsic rather than intrinsic motivations (i.e., so as to fulfil their parents' expectations and achieve academic advancement through public examinations; Chen et al., 1996; Tweed &

Lehman, 2002; Yeung et al., 2020). In addition, influenced by its colonial history, the learning of English remains prevalent among Hong Kong students at different academic levels, which accordingly influences students' participation in reading activities (Tse, 2017).

At the same time, due to its over-reliance on drilling practice, the way in which the Chinese language is taught in Hong Kong has regularly been criticized by educators. For instance, students typically learn Chinese characters (the basic unit of written Chinese) through a "look-and-say" or rote memory approach (Loh et al., 2021). Furthermore, Chinese reading classes are largely oriented around examinations and focused on activities such as explaining model texts to students, or on exercises designed to help students acquire linguistic and rhetorical knowledge (Lau, 2007; Zhu et al., 2016). Following the curricular reforms carried out in 2000 and updated in 2017, a competence-based approach (Lau, 2006, 2007; Tse, 2017) has been established with the primary aim of developing students' higher-level reading skills by considering the cognitive processes of reading (Liao & Zhu, 2020). The pedagogical goal of Chinese language education in Grades 1–3 is to foster students' listening and speaking skills while in Grades 4–6, the teaching focus shifts to enhancing students' written language competence. Students are expected to increase their vocabulary, master reading strategies, and gain confidence in and enjoyment from reading and writing (Curriculum Development Council, 2017). The achievement of these goals will require greater levels of engagement in reading among primary school students.

The education setting and cultural characteristics in Hong Kong presented a unique context for examining how reading motivation affects comprehension. Based on the literature outlined above, the current paper primarily focuses on the following two research questions:

1.How exactly do reading amount and strategy use mediate the relationship between intrinsic reading motivation and reading comprehension between Grade 4 and Grade 6 in primary students in Hong Kong?

2. Does the mechanism by which intrinsic reading motivation influences reading comprehension vary across different grades of primary school students?

Research Methods

Participants

This study initially involved 545 students from primary schools of three bandings in Hong Kong, namely Bands 1, 2, and 3.[1] Among these participants in the

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[1] The bandings of schools are roughly determined by the overall academic performance of the students enrolled, with Band 1 usually recruiting students who are academically superior to their peers, followed by Band 2 and Band 3. However, irrespective of school bandings, they share the same central curriculums launched by the government of Hong Kong. In this study, we also ran the ANOVA and found that students' performance in the four variables did not significantly vary by school bandings: that is, for reading comprehension, $F_{(2, 534)} = .957$; for strategy use, $F_{(2, 534)} = 1.359$; for reading amount, $F_{(2, 534)} = 1.234$, for reading motivation, $F_{(2, 534)} = .780$, with all p values larger than .05. Therefore, we considered it theoretically unnecessary to nest students by school bandings.

project, eight students were not able to complete the reading tasks due to being off sick, leaving a total of 537 participants. Of these participants, 266 were in Grade 4 (M age = 9.75 years; 136 boys and 130 girls) and 271 were in Grade 6 (M age = 11.5 years; 136 boys and 135 girls). Consent letters were obtained from all participating students and their parents prior to data collection. All students reported that they had been born in Hong Kong and spoke Cantonese as their first language.

Instruments

Reading comprehension task

Reading comprehension in this study was defined as *the skills to extract meaning or to learn from texts* (Rupley & Blair, 1983; Snow, 2002), and as *a complex process involving various cognitive abilities such as thinking, reasoning, imagining, and interpreting* (Kamhi-Stein, 2007). To assess students' Chinese reading comprehension skills, a comprehension task was developed. We employed an influential three-level comprehension competence framework (Basaraba et al., 2013) using the following: (1) literal comprehension (retrieving explicitly stated information); (2) inferential comprehension (understanding the implicit relationships in the passage); and (3) evaluative comprehension (analyzing and critically interpreting the text). The details of the reading task are elaborated below.

Reading Texts

The task contained two narrative texts. Narrative texts were chosen because students would feel most comfortable while reading a genre that is the most common category of text at the primary learning stage. To ensure the appropriateness of the texts for students in both graders, we first invited a veteran teacher from a local primary school (a coordinator of Chinese language teaching) to recommend suitable texts for inclusion in the reading task. Following extensive discussion, we chose two texts based on three criteria: the texts had to be "close to students' lives", of "proper length", and "suitable for constructing questions to measure reading skills". The first text, titled "Wyra's Job Hunting" (665 Chinese characters), was a non-fiction story about a retired sports star who kept practicing his smile until he succeeded in getting a job. The other was a fictional piece titled "A House Looking for a Home" (1082 Chinese characters), a story about a house that discovered she had no home and started to look for one in cities, villages, and wild fields. We further edited the texts by having researchers delete several difficult words and phrases, and by adding several sentences to improve the texts' overall coherence, thus increasing their suitability as the basis for constructing test questions. With reference to recent studies on Chinese text readability, we used the following formula to assess text difficulty (proposed by Sung et al., 2013, 2016):

Academic Grade Level = 4.53 + 0.01*[proportion of difficult words] – 0.86*[simple sentence ratio] − 1.45*[content word frequency in logarithmic] + 0.02*[personal pronouns].

The two texts' academic grade levels were calculated to be 4.02 and 4.91 respectively, suggesting that they were suitable for students in Grade 4 and above.

Task questions

Based on a three-level comprehension competence framework (Basaraba et al., 2013), 16 task questions were composed by researchers. To ensure the validity of these questions, six experienced local primary school teachers were invited to attend a focus group meeting for task modification. Eventually, 13 questions bearing a total of 75 points were retained for the given task, of which four were multiple choice and nine were short-answer items. The six teachers all agreed that the task constituted a valid method for measuring the reading skills of students in Grades 4 and 6. In addition, the reliability of the 13 items was ensured by their consistency with the comprehension framework. Specifically, two questions were aimed at literal comprehension and worth six points (sample question: "*When the house says 'I never thought of this question', what is the meaning of 'this question'?*"), seven were aimed at inferential comprehension and worth 49 points (sample question: "*What is the main idea of the story?*"*)* and four were aimed at evaluative comprehension and worth 20 points (sample question: "*The manager laughs in Wyra's face. Do you think this is appropriate, and why or why not?*"). We developed a scoring scheme for the reading task according to this framework and further revised it based on students' responses in the pilot study.

Validity and reliability of the reading task

To further guarantee the validity and reliability of the reading task, we used Exploratory Factor Analysis (EFA) to examine its construct validity. The Kaiser–Meyer–Olkin (KMO) value for the sample data was 0.833, indicating that the correlations among different reading skills were suitable for factor analysis (Tabachnick et al., 2007). The Bartlett's test of sphericity ($\chi^2 = 770.03$, $df = 78$, $p < 0.001$) indicated that the correlation matrix among different skills was not an identity matrix and that the EFA was meaningful. Thus, three components were extracted using the principal components analysis with varimax rotation, accounting for 40.44% of the variance in reading comprehension. The loadings of the reading questions were all significant as they were above 0.30 (Hair et al., 2010). The loadings of literal comprehension ranged from 0.711 to 0.594, those of inferential comprehension from 0.343 to 0.677, and those of evaluative comprehension from 0.381 to 0.737, all of which showed that these questions represented three underlying components well and that the skills were internally connected. The task also had good reliability, with a Cronbach's alpha value of 0.72. Hence, these three components corresponded well with the three categories of tasks, and the reading task was confirmed to be valid and reliable for assessing students' reading comprehension competence.

Table 1 EFA loadings and reliability of the student questionnaire

Questions	Loadings	Cronbach's Alpha value
Strategy Use: How often do you do the following activities during reading?		0.866
1. I can change my reading method when it is necessary	.813	
2. I check my understanding by asking myself if my thinking is correct	.745	
3. I make predictions about the texts while reading	.823	
4. I search for specific information that I need	.831	
5. I recognize the structure of the text	.808	
6. I try to guess the meaning of unknown words based on the context	.406	
7. I mark useful words and sentences, including words such as "first" and "second" and topic sentences	.407	
Reading Exposure: How often do you read the following types of materials (for at least 15 min at a time)?		0.716
1. Biograph	.764	
2. Fairytale books	.591	
3. Detective novel	.582	
4 Historical story	.730	
5. News report	.431	
6. Science trade books	.593	
Reading motivation: To what extent do you agree with the following statements?		0.832
1 Reading is interesting	.590	
2 It is important for me to read more books	.760	
3 The content of textbooks is interesting	.755	
4 I like reading some extra-curricular books chosen that I choose myself	.661	
5 I like reading with my family	.630	
6 I am often affected by the text when I am reading	.674	
7 I like participating in the extensive reading activities in school	.630	
Overall reliability (Cronbach's Alpha)		.880

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

Student questionnaire

There are two frequently-used approaches to collecting data on students' reading motivation or behavior: one relies on the teacher's judgment (Wigfield et al., 2008), while the other is based on self-reporting by students (Skinner et al., 2009). Considering the tight teaching schedule of each participating school, we considered the latter approach a more reasonable choice. The four-point Likert questionnaire was established with the following three major sections (see Table 1):

1The Strategy Use Scale consisted of seven 4-point items to tap into students' frequency of reading strategy use (1 = Never use, 2 = Rarely use, 3 = Sometimes use, 4 = Often use) which were selected from the literature (e.g., Authors 2 & 3, 2019, 2020) with reference to the curriculum document launched by the education authority in Hong Kong.

2.The Reading Amount Scale was adapted from Cox and Guthrie (2001) and PIRLS 2006. It also employed a 4-point Likert-type format, asking students to report how often they read different types/genres of materials—namely, biography, fairytale, detective novel, news report, historical story, and science book—for at least 15 min at a time. The options were "1 = almost never", "2 = about once a month", "3 = about once a week", and "4 = almost every day". These genres were adapted from PIRLS and the genre matrix of the National Assessment of Educational Progress (NAEP, 2009). They were also considered the most frequently read by primary students in Hong Kong, based on the in-depth discussion with the experienced teachers who had reviewed our reading test questions. This scale is also aligned with the Chinese curriculum requirement in Hong Kong that aims to encourage students to read abundant and diversified texts (Curriculum Development Council, 2017).

(3) The Intrinsic Reading Motivation Scale (seven items) was designed based on previous motivation literature (Baker & Wigfield, 1999) and the PIRLS's classification of reading motivation (Mullis et al., 2012, 2017). It assessed students' reading intrinsic motivation in terms of reading interests (such as "*reading is interesting*" and "*I like reading with my family*"), importance (such as "*It is important for me to read more books*"), and involvement (such as "*I am affected by the text when I am reading*"). Participants answered each item on a 4-point scale (1 = least agree, 2 = somewhat agree, 3 = agree, 4 = strongly agree).

To ensure that the questionnaire was valid and comprehensible for students, we discussed and amended it with six veteran teachers through focus group discussion.

Validity and reliability of the questionnaire

The KMO value of the questionnaire (0.907) and Bartlett's test of sphericity ($\chi^2 = 3999.60$, $df = 190$, $p < 0.001$) indicated that the questionnaire data was suitable for EFA. Three major factors were extracted using the principal axis factoring method and varimax rotation; they explained 51.41% of the total variance in reading engagement. As shown in Table 1, the loadings of strategy use items ranged from 0.406 to 0.831; reading amount items, from 0.431 to 0.764; and reading motivation items, from 0.590 to 0.760. These results indicated that the questionnaire had good

construct validity, as expected. Furthermore, as shown in Table 1, the questionnaire also had good reliability with a desirable Cronbach's alpha value.

Procedure and data analysis

The procedure employed in this study involved two major sessions: the reading task and the post-task questionnaire. The two sessions were administered sequentially one the same day: students first were required to complete the comprehension task within 45 min, followed by the questionnaire which took around 10 min. For Grade 4 students, the task and questionnaire were administered in the first or second month (i.e., September to October) of the academic year; for Grade 6 students they were administered during the last two months (i.e., May and June).

The students' scripts for the reading task were marked by a Chinese language teacher with an MA degree in Chinese Linguistics, who have had at least five years of teaching experience. First a trial marking of 30 student scripts was completed, and then the marking scheme was adjusted based on the results of the trial and the marker's suggestions. Then, 70 students' task scripts were randomly selected and marked simultaneously by researcher and marker. The interrater reliability represented by the Spearman rank correlation coefficient between total scores was 0.871 ($p < 0.001$). Finally, the remaining scripts were all marked by the marker.

Students' performance in the reading task and their responses to the engagement questionnaire were entered into SPSS 24 for further statistical analysis. Descriptive analysis and correlation analysis were first performed to get an overall picture of the dataset. Then, AMOS 24 was employed to further perform structural equation modeling. Prior to measuring the differences in the structural relationship between latent variables, it was necessary to confirm three levels of measurement invariance with increasing constraints (Kline, 2005). These levels were (a) *configural invariance*, indicating that the latent variables were supported by the same observations across groups; (b) *metric invariance*, suggesting that the latent variables had equal loadings because each item contributed to the latent factor to a similar degree across groups; (c) *scalar invariance*, indicating that the levels of the latent variables were similar across groups (as not only the factor loadings but also the intercepts of each item were assumed to be equal). However, full invariance was not tenable in most practices, and thus partial invariance could be allowed for metric and scalar invariance (Byrne et al., 1989). With all these models checked, we performed multiple structural invariances tests to identify possible sources of variance in structural paths when necessary.

The model fit of each model was considered satisfactory if the following criteria were met: CFI ≥ 0.90, RMSEA ≤ 0.06, and SRMR ≤ 0.08 (Hu & Bentler, 1999). To determine the significance of the indirect effects in each model, bias-corrected bootstrapping was performed by 2,000 random samplings with replacements at 95% of confidence level (CI). The indirect effects were assumed to be significant when zero was beyond the confidence interval.

Results

Preliminary analysis

The means and standard deviations of the total scores for the four variables examined in this study are presented in Table 2. The observed variables were calculated only to obtain the overall performance. Normality assumptions of these variables were also checked as both the absolute values of skewness and kurtosis were below 2 (Kline, 2005).

Further correlation analysis reported in Table 3 shows that all three engagement components as predictors (i.e., reading motivation, reading amount, strategy use) were not only significantly correlated with each other, but also significantly affected reading comprehension. The grade level correlated with reading motivation and strategy use (but not reading amount) as well as with the reading comprehension score at a weak to a moderate level.

Basic model demonstrating the effect of reading motivation on comprehension

To examine the effect of reading motivation on comprehension, a basic SEM model was first built with the data of all participating students (as shown in Fig. 2). All three predictors (i.e., reading motivation, reading amount, and strategy use) in this study were treated as latent variables composed of sub-items listed in Table 1 with reading comprehension containing three composite scores for literal, inferential, and evaluative scores. Explaining a 74.4% variance of reading comprehension, the model fit was satisfactory with $\chi^2 = 641.803$, $p < 0.001$, SRMR $= 0.066$, RMSEA $= 0.059$, and CFI $= 0.904$. In this model, all parameters were significant except for the paths from reading amount to reading comprehension ($\beta = -0.01$, $p > 0.05$).

As shown in Table 4, the total effect of reading motivation on reading comprehension was 0.762, $p < 0.01$, 95% CI [0.644, 0.844]. The direct effect of motivation was also significant ($\beta = 0.49$, $p < 0.001$), and its total indirect effect was 0.270, 95% CI [0.177, 0.364], $p < 0.01$, which quantified how much two variables that differed in motivation by a unit were estimated to differ their effect on reading comprehension because of the influence of reading motivation on other mediators, which in turn influenced comprehension performance.

We further decomposed the indirect effect to different paths and found that strategy use could uniquely mediate the relationship between reading motivation and comprehension, with an estimated indirect effect value of 0.242, 95% CI [0.175, 0.319]. Reading amount, on the contrary, did not show such a mediating effect in the relationship between motivation and comprehension. However, it could cause motivation to have a significant two-stage indirect effect (i.e., $\beta = 0.032$, 95% CI [0.006, 0.074]) on students' comprehension results, with reading amount as a first mediator and strategy use as the second.

**Table 2** Descriptive analysis of students' overall scores on respective instruments

	All sample				Grade4				Grade 6			
	Mean	SD	Skewness	Kurtosis	Mean	SD	Skewness	Kurtosis	Mean	SD	Skewness	Kurtosis
1.Reading Score (75)	41.84	12.45	−.618	.376	37.32	12.14	−.757	.348	46.28	11.09	−.522	.004
2.Strategy Use (28)	21.25	5.06	−1.055	.507	20.69	5.74	−.951	−.077	21.80	4.22	−.934	.547
3.Exposure (24)	14.87	3.99	−.019	−.586	15.07	4.40	−.093	−.821	14.67	3.53	.030	−.345
4.Motivation (28)	20.57	4.77	−.789	.217	19.92	5.05	−.721	−.060	21.20	4.40	−.798	.418

The digits in the brackets are the full score of the respective instrument

Table 3 Correlation matrix between students' overall score on respective instrument

	1	2	3	4	5
1.Reading Score	1				
2.Strategy Use	.617***	1			
3.Reading Exposure	.304***	.370***	1		
4.Reading Motivation	.580***	.506***	.384***	1	
5 Grade	.360***	.110*	.050	.134**	1

***p < .001, **p < .01, *p < .05
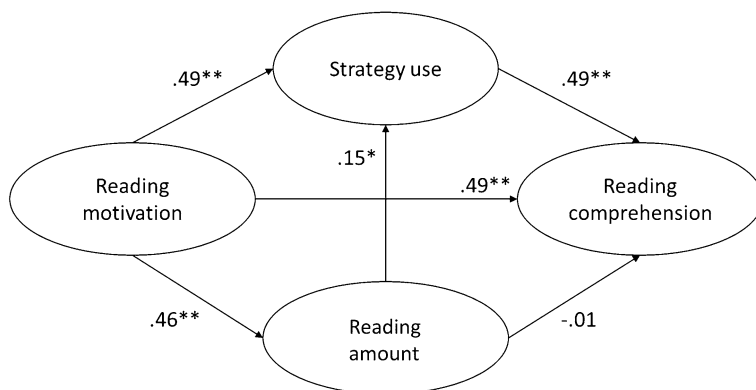
Fig. 2 A basic structural model demonstrating the direct and indirect effects of reading motion on reading comprehension. *Note: ***p < .001, **p < .01, *p < .05*

Measurement invariance in the effect of reading motivation on comprehension across students in Grades 4 and 6

The baseline model reported in the last section also fit well when estimated separately in the student group of each grade: for Grade 4 students, χ^2 (224) = 464.53, RMSEA = 0.064, SRMR = 0.068, and CFI = 0.904; for Grade 6 students, χ^2 (225) = 386.913, p < 0.001, RMSEA = 0.052, SRMR = 0.071 and CFI = 0.908, p < 0.001. The path coefficients were listed in Fig. 3.

The *configural measurement invariance* model showed good fit indices between grades: χ^2 (448) = 851.444, p < 0.001, CFI = 0.906, RMSEA = 0.041 and SRMR = 0.068, suggesting that the general factor structure of all relevant variables was comparable between Grades 4 and 6. The further *metric measurement invariance* model also showed good fit indices between two grade levels: χ^2 (467) = 880.931, p < 0.001, CFI = 0.903, RMSEA = 0.041 and SRMR = 0.072. Moreover, since the comparison between the *configural* and *metric* invariance models was found to be non-significant—$\Delta\chi^2$ (19) = 29.487, p > 0.05 (Cheung & Rensvold, 2002)—the assumption of metric invariance across grades was confirmed. Although metric invariance was considered sufficient to explore the structural relationships between latent variables, we further tested the *scalar invariance model* by

Table 4 Mediating effects of strategy use and reading amount

	All participants			Grade 4			Grade 6		
	Effect	95%CI low	95%CI high	Effect	95%CI low	95%CI high	Effect	95%CI low	95%CI high
1.RM-SU-RC	.242**	.175	.319	.292***	.176	.445	.205***	.121	.327
2.RM-RA-RC	−.005	−.062	.056	.038	−.039	.154	.018	−.067	.140
3.RM-RA-SU-RC	.032*	.006	.074	.078***	.026	.162	.000	−.033	.039
Total indirect	.270**	.177	.364	.408**	.288	.547	.224**	.095	.403
Total effect	.762**	.664	.844	.698**	.552	.821	.935**	.768	1.128

Mediation effect is the results multiplied by two coefficients. RM = Reading motivation; SU = Strategy use; RA = Reading amount; RC = Reading comprehension; *p < .05; **p < .01; ***p < .001
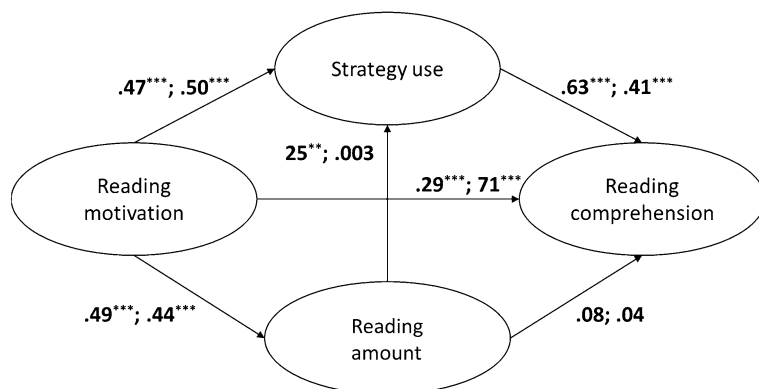
Fig. 3 Full mediation model across grade levels. *Note: *p < .05, **p < .01, ***p < .001.* The left-hand digit on each path represents the standardized regression coefficient for Grade 4 students; the right-hand digit represents the coefficient for Grade 6 students

constraining the incepts of all variables to ensure the mean of each latent variable comparable. However, we found that the *scalar model* was significantly different from the *metric invariance model* ($\Delta\chi^2$ (23) = 204.631, $p < 0.001$) as 11 out of 20 intercepts did not hold invariance across groups. In this case, we decided to allow these intercepts to be free across groups, and thus a *partial scalar invariance model* was obtained: χ^2 (479) = 893.522, $p < 0.001$, CFI = 0.903, RMSEA = 0.040, and SRMR = 0.072.

Based on the partial scalar invariance model, we further examined the *structural invariance model,* which imposed grade-equality constraints on all path coefficients. The fit of the model was good: χ^2 (485) = 915.699, $p < 0.001$, CFI = 0.900, RMSEA = 0.041 and SRMR = 0.082. Although the SRMR value was slightly higher than the cut-off value (0.08), all values taken together still suggested the model was of adequate to satisfactory fit. The comparison between the structural invariance model and partial scalar invariance model showed that the model fit had significantly changed—$\Delta\chi^2$(6) = 22.18, $p < 0.01$—indicating that the model fit across two groups is different in some aspects. Next, we checked whether the model fit could change significantly accordingly if imposing equality on one path between latent variables and setting free to others at the same time. It turned out that most of the paths did not change significantly across grades. There were two exceptions: one was the direct effect of motivation on comprehension ($\Delta\chi^2$(1) = 9.882, $p < 0.01$), and the other was the effect of reading amount on strategy use ($\Delta\chi^2$(1) = 3.97, $p < 0.05$). Therefore, the direct effect of motivation on comprehension in Grade 4 ($\beta = 0.29$, $p < 0.001$) could be considered significantly lower than in Grade 6 ($\beta = 0.71$, $p < 0.001$), and the effect of reading amount also had a significantly higher effect on strategy use in Grade 4 ($\beta = 0.25$, $p < 0.01$) than in Grade 6 ($\beta = 0.003$, $p > 0.05$).

In view of the results of the group comparison, the various indirect effects in each grade were examined using a bootstrapping approach. Table 4 indicates that the effect size of reading motivation might not be the same for the two grades. The indirect effect of motivation on comprehension was 0.408 in Grade 4 and dropped

to 0.224 in Grade 6, accounting for 58.45% (i.e., 0.408/0.698) and 23.96% (i.e., 0.234/0.935) of the total effect respectively. It should be noted in particular that the two-stage mediating effect (i.e., reading motivation→reading amount→strategy use→comprehension) dropped significantly from 0.078 to 0 from Grade 4 to Grade 6, $p < 0.05$, [0.098, 1.82].

Discussion

The present study aimed to comprehensively examine how reading motivation works together with strategy use and reading amount to affect reading comprehension in a Chinese-language context. Since reading motivation, reading amount, and strategy use are usually seen as essential components of reading engagement (Guthrie et al., 1996; Lee et al., 2021; McElhone, 2012), the findings also extend our knowledge about the relationship between reading engagement and reading comprehension and its generalized applicability among learners in different contexts.

The mediating effects of strategy use and reading amount in the relationship between intrinsic motivation on reading comprehension

In this study, we focused particularly on the possible mediating effects of strategy use and reading amount in the relationship between reading motivation and comprehension (i.e., the first research question). Mediation analysis has been widely conducted in previous literature to explore the underlying mechanism of the focal effect of intrinsic motivation on reading comprehension and has generated contradictory findings. While some have proposed that reading strategy (e.g., Völlinger et al., 2018) and reading amount (e.g., Miyamoto et al., 2019; Schaffner & Schiefele, 2016) significantly mediate the effect of reading motivation on reading comprehension, others have argued the opposite (e.g., Troyer et al., 2019). In these circumstances, our study has examined the mediating effects among Chinese primary students and attempted to explore more possible pathways to produce these effects.

Through structural equation modeling, we confirmed that among primary school students in Hong Kong, strategy use was in fact a significant mediator in the relationship between reading motivation and comprehension—this result is consistent with the findings of Völlinger et al. (2018) and Miyamoto et al.'s (2019) findings. Thus higher levels of reading motivation can trigger more frequent utilization of reading strategies, especially deeper level strategies, from which it was possible to predict better performance in reading comprehension (McDaniel et al., 2000; Meece et al., 1988; Naceur & Schiefele, 2005; Nolen & Haladyna, 1990; Schiefele, 1990).

However, our study has not confirmed the mediating role of reading amount, since reading amount failed to predict reading performance despite the significant prediction of reading motivation towards reading amount. This result echoed research conducted among Chinese (Wang & Guthrie, 2004; Wang et al., 2020) and

American students (Troyer et al., 2019), but contrasted with other studies conducted in Germany (e.g., Miyamoto et al., 2019; Schaffner & Schiefele, 2016). This further suggested that the indirect effect of reading motivation could be context-specific rather than context-general. Our interpretations are twofold. First, reading amount itself may not strongly influence students' comprehension. For instance, the results of the meta-analysis carried out by Byrnes (2000) showed that the values of *correlation* for reading amount ranged from 0.1 to 0.4, which was considered relatively weak. In other words, greater reading amount may not always translate into higher levels of literacy. Second, under the examination-oriented condition in a Confucian cultural context (such as in Hong Kong), students, teachers and parents all focus significantly on practicing exam techniques and put less emphasis on reading for fun, so students possibly read because of examination pressure or in response to teachers and parents' instructions rather than for pleasure. This would likely to hamper "the quality of reading investment" (De Naeghel et al., 2012). That is why the effect of reading amount on comprehension was not as significant as we anticipated.

Although reading amount was not shown to mediate the relationship between reading motivation and reading comprehension, this study further suggested that reading amount could work together with strategy use to exert a two-stage mediating effect on reading comprehension; that is, intrinsic motivation had the effect of increasing students' reading amount and further encouraged them to acquire and employ more reading strategies through reading, thus eventually advancing their reading performance (Guthrie et al., 1996, 1999; Schnotz, et al., 2017). Taking into consideration the insignificant mediating effect of reading amount as a unique mediator, strategy use seemed to be important in accounting for the relationship between reading amount and comprehension. In other words, strategy use could be the facilitator that enhances the effect of students' increased reading frequency on comprehension. Linking with the classical Matthew effect in reading theory (Stanovich, 1986) that claims good readers read more and poor readers read less (and therefore that the gap between proficient and struggling readers widens over time), the findings of our study lead us to assume that good readers could become more strategic through extensive reading, which would enable them to grow into better readers. In contrast, the fact that poor readers are not able or are unwilling to read extensively, which hinders the development of strategy competence in reading, consequently causing a lag in the development of reading skills.

To our knowledge, such a two-stage indirect effect has seldom been reported in the literature to date, and thus this finding can serve as new evidence for research into the mechanism linking reading motivation to comprehension. However, as we will discuss in the next section, it should be cautiously noted that this two-stage indirect effect may be more applicable for Grade 4 rather than Grade 6.

Differences in the pathways by which motivation impacts reading comprehension across grades

In addressing our second research question, we further investigated whether there were any significant grade differences in the relationship between reading

motivation and comprehension. Generally speaking, no significant difference was found in the magnitude of most paths between different the variables across the two grades, which indicated that the mechanism of motivation contributed to reading comprehension similarly for students in both grades. For instance, intrinsic motivation could lead to significant increases in students' use of reading strategies and their exposure to reading materials, further adding to the significant indirect effects on comprehension via the mediation of strategy among students in both grades.

However, our analysis showed that the effect of reading amount on strategy use was significantly higher among students in Grade 4 than in Grade 6, which led to a significant change in the size of the two-stage indirect effect of motivation on comprehension. To account for this, we referred to the findings of Anderson et al. (1988), who showed that primary school students' reading frequency improved reading proficiency at first, but that this effect diminished with increases in time spent reading. In light of this, we assumed that a similar effect from reading amount might also operate on students' employment of reading strategies. In other words, the effect of reading amount on strategy use could be more prominent in younger students—particularly those in Grade 4—because these students were at a key stage of transition from "learning to read" to "reading to learn" and were suddenly required to deal with an increased amount of reading materials. It is possible that a large amount of reading would lead to an urgent demand among these students to use strategies to process the materials efficiently (Author 3, 2020; Torgesen, 2006). Given the strategic knowledge that they had already accumulated through investing time in reading, Grade 6 students should have grasped the necessary comprehension skills and even automatized some strategies while reading. In this sense, increased reading amount could strongly predict improvements in strategic skills following the sudden demands placed on teachers and students at a given learning stage. Our findings also echoed to some extent Miyamoto et al. (2019), who found that mediating effect was more critical among lower-ability students.

This study also found that intrinsic motivation played a more critical role in Grade 6 students than in Grade 4 students, as manifested by the significant rise of direct effect and total effect from motivation towards comprehension. These findings were in alignment with those of Saarnio et al. (1990) and Sideridis et al. (2006), who both showed how motivation seemed to be more closely connected to comprehension among students in higher grades or those of stronger reading ability. To explain this, we inferred that as grade level increases, the texts to which students were exposed are both presented in longer format and increasingly complex, which required students to demonstrate greater involvement and endurance in reading. Walker et al. (2006) claimed that students with higher intrinsic motivation tended to stay focused on difficult learning tasks and made more effort even when confronting with failures. Therefore, intrinsic motivation allowed students in higher grades to persevere through meaningfulness or personal involvement in reading (Harackiewicz et al., 2000).

It is necessary to note that Grade 6 students demonstrated higher motivation than Grade 4 students in this study, which contrasted with the findings of various previous studies showing a decline in students' motivation over time (e.g., Lepper et al., 2005; Schaffner et al., 2016; Vaknin-Nusbaum et al., 2018). However, the present

study concurred with other studies (Wolters et al., 2014; Lau, 2016) and demonstrated that a decline in reading motivation in tandem with grade progress was not universal. We therefore cautiously assumed that our own findings might be associated with the particular educational context in Hong Kong.

As stated earlier, primary students in Hong Kong commonly learn to read traditional Chinese. To learn Chinese—which, as a logographic language, is remarkably different from alphabetic orthographies (e.g., English)—students must learn individually each Chinese character that stands alone (a morpheme). Unlike mainland China and Taiwan, where pinyin (a phonetic system transcribing the pronunciation of Chinese characters) has been widely used in Chinese classrooms to assist students in reading, the prevailing approach to teaching Chinese characters in Hong Kong primary schools is still rote memorization. Therefore, students in lower grades can often encounter unknown characters and have little idea of what they mean (Loh et al., 2021; McBride, 2016). As pointed out by Medford and McGeown (2012), students could be discouraged if they experience repeated difficulties or barriers, which may subsequently reduce their reading motivation. Alternatively, if students frequently have successful experiences of reading, they can gradually build up enjoyment of reading and develop their reading motivation. Moreover, the Expectancy-Value theory posits that students' motivation is strongly influenced by their estimated probability of their success and perceived importance of and interest in the task (Wigfield & Eccles, 2000). Therefore, the lower levels of motivation of Grade 4 students might be linked to their more limited knowledge of the Chinese language, which may hinder their interest in reading books. Students in Grade 6, in contrast, were able with sufficient relevant linguistic knowledge to read texts fluently, and their enjoyment of reading increases accordingly.

Conclusion and Implications

By re-examining in a Chinese learning context claims about the indirect effects of reading motivation on comprehension via the mediation of reading amount and strategy use, we have extended the scope of study in this area to explore the two-stage indirect effect of motivation (i.e., reading motivation→reading amount→strategy use→reading comprehension). Because this was an exploratory study, we did not adopt a longitudinal approach to address the possible reciprocal relationships between reading motivation and reading comprehension at a given stage.

Despite its significance, we also must admit that there exist several limitations in this study. First, due to lack of data, variables such as participants' socio-economic status and prior reading performance were not controlled in data analysis. Second, the measurement of reading amount did not directly tap into the actual time students devoted to reading, which could also be a possible factor causing the insignificant mediating effect of reading amount. A more comprehensive and direct approach, such as reading log, would provide more evidence in future studies. Third, the mediating effects found in this study were based on the correlational analysis of quantitative data, and thus the causational inference should be treated with caution. Finally, because to our knowledge there is no standardized comprehension test in Chinese,

the reading comprehension test was self-designed by the researchers, and therefore the findings of our study may be less generalizable.

Nevertheless, the results can deepen our theoretical understanding and provide implications for the teaching of reading comprehension in Hong Kong. Given the examination-oriented nature of education in Hong Kong, we observed that there was a genuine need to effectively raise students' motivation to read in a true sense despite the observed stronger motivation of Grade 6 students in this study. This can be realized through various methods. For instance, schools and teachers could allow students to choose a variety of books themselves or give appropriate encouragement at the right moment (Merga, 2016). Furthermore, we can also boost students' situational interest as previous research has found that young children display different levels of interest in different tasks (Graham et al., 2008). Therefore, tasks can be designed in more diverse and attractive ways, such as by focusing on topics in which students are interested. More essentially, reducing the amount of extra stress that students experience from public examinations might encourage them to read out of their own interest, beyond what is compulsory in the curriculum.

Additionally, based on the findings that the influence of reading motivation on reading comprehension could be mediated through reading strategy and the two-stage mediating effect of reading amount and reading strategy, it might be profitable to employ interventions in Chinese language teaching that promote the use of effective reading strategies and encourage extensive reading. Although the significance of both is emphasized in many Hong Kong primary schools' curriculums and teaching guidelines, the current situation of students' reading practices and the situation in the Chinese reading classroom are less satisfactory than educators may have anticipated (Liao & Zhu, 2020). Further efforts are needed to improve awareness among Chinese teachers of the importance of the two mediating factors. Regarding strategy instruction, only a limited number of strategies are being taught in the classroom, such as summarizing main ideas, searching for information from texts, or explaining the meaning of text contents (Mullis et al., 2017; Liao & Zhu, 2020). It could be suggested that students be taught a more diverse range of reading strategies in future. Regarding the reading amount variable, we observed that primary school teachers tended to minimize their role in encouraging extensive reading as they consider this to be duty of the school librarian (Zhu & Liao, 2013). Greater involvement from teachers could facilitate students' mastery of more advanced reading strategies through extensive reading (Topping et al., 2007). Therefore, Chinese teachers are encouraged to provide more scaffolding for students to develop their reading skills, both in and out of class. For example, to activate students' motivation to read and develop their use of reading strategies, teachers could organize a variety of extensive reading activities for their students such as a literature circle, sustainable silent reading, and thematic reading. Through these activities, students could enjoy more freedom to select books they like and report their achievements, and thus achieve better performance in reading and ultimately grow to be successful, self-motivated learners.

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