

# Influence of After-School Tutoring on Reading Comprehension Skills of Chinese Primary School Students with Dyslexia: A Mixed-Methods Study

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**Abstract:** This study explores the influence of after-school tutoring on reading comprehension skills of students with dyslexia (DD) in grades 3–5 in China and its participating factors. Using a mixed-methods design, the quantitative data (GORT-4 reading test) of 50 public primary school students in Qingdao and their parents' feedback were collected through questionnaires, supplemented by semi-structured interviews with eight parents for qualitative analysis. The findings are as follows: (1) Family socioeconomic status and parents' awareness of DD are the key factors to participate in after-school counseling; (2) The students who participated in the after-school counseling performed significantly better in the GORT-4 comprehension test ( $P < 0.05$ ); (3) Counseling makes up for the lack of classroom learning through personalized strategies (such as multi-sensory teaching and phonological awareness training), but parents' psychological support is the core of successful intervention. The necessity of early targeted intervention was emphasized, and practical enlightenment was provided for the educational support system of DD students in China.

**Keywords:** Dyslexia; After-school counseling; Reading comprehension; Students; Study on hybrid method; Chinese education

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## 1. Introduction

### 1.1. Research background and significance of problems

Developmental dyslexia (DD) is a specific learning disorder based on neurobiology, which is characterized by difficulty in word decoding, poor reading fluency, and poor spelling ability. About 5–17% of school-age children in the world are affected by it <sup>[1]</sup>, while the prevalence rate of DD among primary school students in China is 3–10%. Although DD children often have a normal intelligence level, their reading ability is difficult to reach the academic benchmark, which leads to long-term academic frustration, reduced self-efficacy, and mental health risks. It is worth noting that Chinese dyslexia is unique: the ideographic nature of Chinese orthography makes DD students face more obvious phonological awareness defects and the delay in writing Chinese

characters<sup>[2,3]</sup>, which puts forward the localization demand for intervention strategies.

Worryingly, there is a “cognition-support” gap in the educational environment in China: the recognition rate of DD between teachers and parents is less than 30%<sup>[4]</sup>, and social stigma aggravates the psychological pressure of DD children. Early intervention has been proven to significantly improve the prognosis of DD, but it is difficult for mainstream classrooms to provide personalized support. In this context, after-school tutoring, as the core form of “shadow education”<sup>[5]</sup>, has become an important way to make up for the teaching gap.

## 1.2. After-school counseling mechanism and research controversy

After-school tutoring provides supplementary academic support through small classes or one-on-one teaching, and its effectiveness has been verified in many languages:

- (1) Cognitive improvement: American RCT research shows that two years of after-school tutoring can improve DD students’ reading fluency by  $d = 0.45$ <sup>[6]</sup>;
- (2) Psychosocial benefits: Reducing academic anxiety and enhancing learning motivation<sup>[7]</sup>;
- (3) Intervention efficiency: Teacher-led counseling is more effective than the volunteer mode<sup>[8]</sup>.

However, the existing research has obvious limitations:

- (1) Lack of cultural adaptability: Western-led speech intervention strategies (such as phoneme segmentation training) are not compatible with Chinese syllable structure<sup>[2]</sup>;
- (2) Methodological simplification: Over-reliance on quantitative design (such as China’s research by Johnson *et al.*<sup>[9]</sup>) and neglect of situational mechanism analysis;
- (3) Insufficient ecological validity: The influence of key socio-ecological factors such as parents’ cognition and family socio-economic status (SES) on the intervention effect was not investigated.

## 1.3. Research purpose and value

Based on the above gaps, this study adopts a mixed method to explore three core issues:

- (1) What social and ecological factors (family SES, parents’ DD cognition, and school support) affect DD students’ participation in after-school tutoring in China?
- (2) How does after-school tutoring affect DD students’ Chinese reading comprehension ability (measured by standardized GORT-4 test)?
- (3) What are the key success factors (such as teaching strategies and home-school cooperation model) in the process of counseling?

## 2. Literature review

### 2.1. Multi-dimensional cognitive mechanism of dyslexia

#### 2.1.1. Cross-language core defect: Speech processing theory

The phonological deficit hypothesis of DD has been widely proven as the core mechanism of cross-writing systems. Its performance is as follows:

- (1) Weak phoneme awareness: It is difficult to operate the smallest phonetic unit (such as English phoneme /b/ vs /p/).
- (2) Naming speed delay: The reaction time of RAN (Rapid Automated Naming) task is prolonged by 30–50%.
- (3) Phonetic working memory is limited: The score of the digit span test is significantly lower than that of peers<sup>[1]</sup>.

Neuroimaging studies further reveal the neurobiological basis of DD: Insufficient activation of the left temporoparietal junction (TPJ) and superior temporal gyrus (STG) leads to abnormal phonetic-glyph mapping.

### 2.1.2. The uniqueness of Chinese dyslexia: the interaction between orthography and pronunciation

Chinese, as a deep ideographic language, shows specificity in DD (see Table 1):

**Table 1.** Comparison of cognitive differences between Chinese and Pinyin reading disabilities

Cognitive dimension	Pinyin characters (English)	Chinese	Key evidence
Speech processing	Phoneme segmentation is difficult	Tone recognition error rate = ( $d = 1.2$ )	Wang & Yang (2018) <sup>[2]</sup>
Orthographic processing	Letter sequence memory defect	Processing delay of stroke structure (RT > 800 ms)	Lam <i>et al.</i> (2011) <sup>[3]</sup>
Morpheme consciousness	Weak predictive power ( $\beta = 0.15$ )	Core predictor ( $\beta = 0.62$ )	Liu <i>et al.</i> (2016) <sup>[10]</sup>
Reading fluency	Word decoding speed defect	Chinese character naming speed ↓40%	Cai <i>et al.</i> (2020) <sup>[11]</sup>

Example: Liu *et al.*<sup>[10]</sup> found that the correct rate of Chinese DD children in the phonetic consistency task was only 41%, which was significantly lower than that of the control group (89%), which proved that the broken grapheme-phonetic connection was its core defect.

## 2.2. Evidence of the effectiveness of after-school counseling intervention

### 2.2.1. International practice: Positive effects of structured counseling

As a compensatory education, the effectiveness of after-school counseling is confirmed by three research paradigms:

Randomized controlled trial: After two years of tutoring, the effect of improving reading fluency of 1,840 primary school students in the United States,  $d = 0.45$  (95% CI [0.32, 0.58])<sup>[6]</sup>.

Longitudinal follow-up: The high school graduation rate of DD students who participated in counseling was  $\leq 28\%$  (OR = 2.1,  $P < 0.001$ )<sup>[12]</sup>.

Cost-benefit analysis: Every \$1 spent on tutoring generates \$3.2 in social benefits (the return on education is 162%)<sup>[5]</sup>.

Key success factors include:

- (1) Intervention intensity:  $\geq 3$  times a week, each time  $\geq 45$  minutes<sup>[8]</sup>.
- (2) Professionalism of teachers: The teacher-led effect is 37% higher than that of volunteers ( $\Delta G = 0.37$ ).
- (3) Multi-sensory integration: Combined with visual-auditory-kinesthetic channel training.

### 2.2.2. Contradictory discovery in the context of China

There are significant differences in the intervention research of Chinese DD (see Table 2):

**Table 2.** Key contradictions of after-school counseling research in China

Research	Design	Main results	Limitations of the method
Johnson <i>et al.</i> (2013) <sup>[9]</sup>	RCT ( $n = 120$ )	The understanding score of GORT-4 in counseling group was $\uparrow 18\%$ ( $\eta = 0.24$ )	Uncontrolled family cultural capital
Huang <i>et al.</i> (2021) <sup>[4]</sup>	National survey ( $n = 2k$ )	There is no correlation between counseling participation rate and grades ( $r = 0.07$ , $P = 0.21$ )	Relying on subjective reports from parents
Cai <i>et al.</i> (2020) <sup>[11]</sup>	A longitudinal study ( $n = 350$ )	The counseling effect of DD students with high SES is $\uparrow 2.3$ times ( $\beta = 0.31$ )	There is no distinction between tutoring types

The root of the divergence: Western speech decoding-oriented models (such as Phonics training) are incompatible with Chinese morpheme awareness-oriented needs<sup>[2]</sup>. For example, the understanding of Chinese

compound words depends on the semantic clues besides the form (such as “river” from “water”), rather than the phoneme combination rules in English.

## 2.3. Research gap and theoretical framework innovation

There are three core gaps in the current field (**Figure 1**):

Gap 1: Lack of a cultural adaptation mechanism

(1) 90% intervention model was developed based on pinyin.

(2) Chinese-specific needs are not integrated:

Phonetic consistency training (such as using the analogy rule of “Qing-Qing/Qing”)

Visual space strategy (Chinese character structure disassembly and component positioning)

Gap 2: Neglect of social ecosystem

(1) Blind spot of parents’ cognition: The awareness rate of DD among parents in China is less than 30% <sup>[4]</sup>.

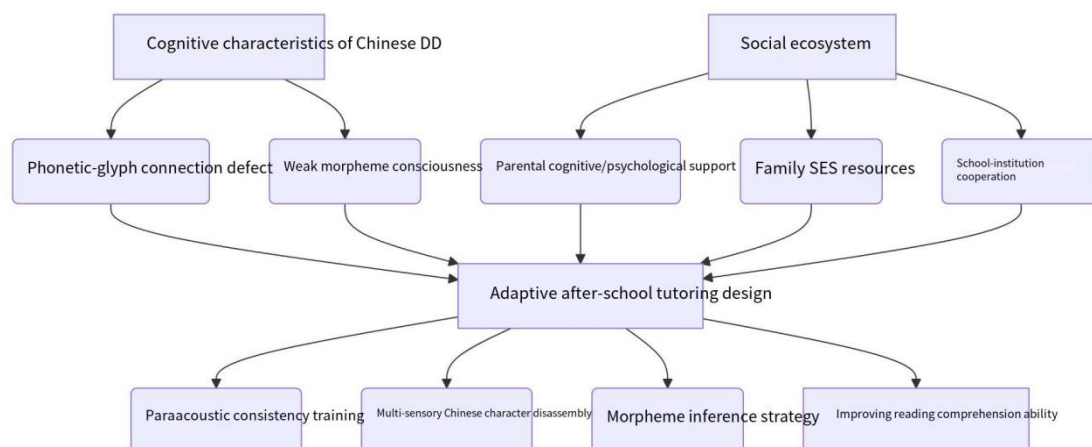
(2) The cooperation between home and school is broken: Only 12% of the courses are connected between schools and counseling institutions <sup>[6]</sup>; Policy constraints: the supply of compliance counseling under the “double reduction” policy is ↓65%.

Gap 3: Methodological simplification

(1) Over-reliance on quantitative results indicators (such as test scores)

(2) Lack of process mechanism analysis; Multiple subject perspectives (teacher/parent/student triangle verification) are not collected.

The theoretical framework of this study: Cognitive-social two-dimensional integration model.



**Figure 1.** Research gap and theoretical framework innovation

Framework description: Based on Bronfenbrenner’s ecosystem theory, micro-system (cognitive training), middle system (home-school cooperation), and external system (policy resources) are included in the intervention design, which breaks through the limitations of traditional pure cognitive intervention.

## 3. Research method

Quantitative methods focus on quantifying data collection and analysis. According to Aliaga and Gunderson <sup>[13]</sup>, quantitative research is the collection of data to explain phenomena, which is objective and statistically significant. In similar research, for example, Shi *et al.* <sup>[6]</sup> used quantitative methods to explore the



factors that influence children from Jinzhong City, Shanxi Province, China to participate in after-school tutoring. Additionally, Johnson *et al.*'s <sup>[9]</sup> study explored the relationship between the impact of reading comprehension on at-risk students in grades 2–5 before and after participating in the intervention with the quantitative method. Therefore, this study will also use quantitative methods to answer the first two questions.

Questionnaires are an effective collection tool <sup>[14]</sup>. The purpose of a questionnaire is to collect data from a large, diverse, and widely dispersed population. Questionnaires ensure a certain consistency between one measurement situation and another <sup>[15]</sup>. At the same time, the anonymity of the questionnaire allows respondents to express their opinions more freely. Questionnaires can also help gather information on sensitive issues and can be analyzed anonymously <sup>[16]</sup>. Thus, more specifically, the first two research questions will be answered through questionnaires.

In addition to exploring the relationship between variables, this study requires further in-depth exploration to understand how after-school tutoring affects the reading comprehension level of Chinese students with dyslexia in grades 3–5. Qualitative research is different from statistical and quantitative procedures. It is a deeper exploration of people's life behaviors, experiences, and attitudes, which means that qualitative research encompasses a greater variety of realities <sup>[17]</sup>. Given that the third research question highlighted the importance of context, a qualitative study was chosen for the second phase.

In qualitative research, an interview is a conversation between two or more people (interviewer and respondent) in which questions are asked to obtain information from the respondent <sup>[18]</sup>. As a conversational type, interviews are one of many modes of human interaction <sup>[19]</sup>. Through dialogue, we learn about other people, their experiences, feelings, and hopes. Kvale <sup>[20]</sup> emphasized that a qualitative interview is a dialogue between the interviewer and the interviewee. The researcher and the interviewee are placed on equal footing. Taylor <sup>[21]</sup> viewed qualitative interviews as conversations in which the researcher gently guides conversation partners into expanded discussion. In this case, the researcher's position is clear because they drive the conversation. Semi-structured interviews can ensure the need to obtain the perspectives of the most important participants and have a certain degree of flexibility, which provides insights into how after-school tutoring affects students' reading comprehension skills <sup>[20]</sup>. Thus, this research will use the semi-structured interview method.

Therefore, these research questions raise both quantitative and qualitative methods. Quantitative and qualitative data are actually inseparable to some extent. Neither exists in a vacuum nor can it be thought of as completely without the other <sup>[22]</sup>. Therefore, this combination of mixed research methods design will allow for in-depth exploration and research on the effect of tutoring on the reading comprehension of Chinese elementary school students with dyslexia <sup>[23]</sup>.

## 4. Data collection

For the quantitative approach, there were two versions of the questionnaire <sup>[24]</sup>. The first version is to explore whether there were significant differences in understanding between GORT-4 scores for students in grades 3–5 who participated in after-school programs and those who did not participate in after-school programs. The second version is to target their parents' perceptions. A questionnaire was conducted on what factors influence students in grades 3–5 to receive after-school tutoring.

Stratified sampling was conducted among students in grades 3–5 at a public primary school in Qingdao City, Shandong Province, China. A total of 50 primary school students and their parents were selected. Previously served as a teaching assistant at this school, the author was familiar with the environment, which facili-

tated data collection and the administration of surveys. Contact had been maintained with the principal of the school, and permission was requested from both the principal and the head teachers of grades 3–5. The principal arranged for the head teachers to distribute the questionnaires, which were completed by the students. The principle of voluntariness was upheld during the data collection process; therefore, only 50 students who expressed willingness to participate were selected to receive the questionnaire. It should be noted that stratified sampling was performed based on the number of students in each grade level to ensure proportional representation. Regarding the scoring standard, students with dyslexia had already been identified through their scores; however, all research data were kept confidential and were not disclosed to avoid causing any harm to the students. Thus, even when students with dyslexia were identified, their scores were not made public, in accordance with ethical research principles.

To identify students with reading difficulties, the detection tool can improve the validity of the study by drawing on the previous study of Johnson *et al.* <sup>[9]</sup>. That is, each student participating in the study was asked to complete two GORT-4 tests, once before and once after the intervention. The reliability of GORT-4 has been tested over time. It is a measure of oral reading comprehension skills, including speed, accuracy, fluency, comprehension, and overall reading ability <sup>[25]</sup>.

Controlling variables is an important part of this study. This study selects control variables for grade and gender factors. Similar studies such as Johnson *et al.* <sup>[9]</sup> conducted a one-way between-group analysis of variance before the intervention to evaluate the impact of grade on GORT-4. This work is done to ensure that students are achieving appropriate reading levels.

For the parent section of the quantitative study, this study is dedicated to finding factors that influence Chinese primary school students with reading difficulties to participate in after-school tutoring. A questionnaire was used to examine whether children participated in after-school tutoring among 50 parents. The questionnaire is a single-choice question that includes factors such as the gender of the child and the socioeconomic status of the family.

At the same time, the subsequent qualitative phase will explore how after-school tutoring affects the reading comprehension ability of Chinese students with dyslexia in grades 3–5. Given the low school age of grades 3–5 and the difficulty of conducting one-to-one interviews as a case of reading difficulty, 8 parents were selected from the parents of students who responded to the questionnaire. The selection of 8 parents made this data saturated, and these 8 parents fully complied with the principle of voluntariness, which means that the parents' active participation enabled the interview to be conducted <sup>[23]</sup>.

The interviews in this qualitative research are in the form of semi-structured face-to-face interviews. In the semi-structured interviews, the order and wording of questions were determined according to the schedule for face-to-face interviews with parents and their replies. Compared with offline interviews, online interviews are cheaper and faster, but the enthusiasm of respondents who often interrupt participation for various reasons may be lower than that of personal interviews <sup>[26]</sup>. Therefore, this study chooses offline interviews, conducted under the conditions of informed consent, anonymity, and no harm, in order to obtain more specific and in-depth results.

In summary, the advantages of collecting both closed-ended quantitative data and open-ended qualitative data help to understand the research question <sup>[27]</sup>. Mixed methods designs can integrate and collaborate with multiple data sources, which can help study complex questions <sup>[28]</sup>.

## 5. Data analysis

Descriptive statistics and correlation analysis will be presented during the quantitative investigation phase, while the qualitative phase will focus on thematic analysis. The quantitative stage and the qualitative stage are analyzed respectively, and then the main conclusions are drawn in the two stages.

This study will use descriptive analysis to explore what factors influence Chinese primary school students with dyslexia to participate in after-school tutoring, and correlation analysis to analyze the relationship between two variables, including students in grades 3–5 as measured by GORT-4 scores and achievements in after-school programs. The dependent variable is the GORT-4 score, and the independent variable is the after-school program status (participating in after-school tutoring or not).  $D_i$  is a dichotomous variable. Children participating in after-school tutoring are marked as  $D_i = 1$ , otherwise,  $D_i = 0$ . The study then turned to using quantitative data to consider question two, like the study by Bridges<sup>[29]</sup>, which compared the assessment results of GORT-4 score comprehension with and without participation. The control variables are the gender and grade of the sample.

Additionally, thematic analysis (TA) is a method of analyzing and identifying themes in qualitative data. The six steps of thematic analysis include familiarization with the data, coding, searching for themes, reviewing themes, defining and naming themes, and writing up<sup>[30]</sup>. The main reason for using thematic analysis in this study is its flexibility. The flexibility of the thematic analysis is not only theoretical but also reflected in the research questions, sample size, and composition. TA is related to the participant's life experiences and opinions and is more suitable for interview data. In this study, parents' thoughts, feelings, and behaviors regarding the role of after-school tutoring for students in reading comprehension can be analyzed during the qualitative phase of understanding. NVivo can import a variety of formats and data types and is a useful tool for organizing, sorting, and analyzing qualitative data. This will support the qualitative analysis phase of my research, as NVivo can easily mark a piece of interview transcripts with node pairs during thematic coding sessions<sup>[31]</sup>.

Additionally, measures are necessary to protect participants. The study is the same as that of McWilliams<sup>[32]</sup>. First of all, the personal information of the student participants is hidden, which means that the research is conducted anonymously. Second, permission was obtained from the principals of the schools selected for this study to collect data. Third, the consent forms and information sheets were sent to those participating in this study. It is important to mention that I am not a passive observer in this study and therefore am not biased<sup>[32]</sup>.

This study is still subject to several limitations. For example, it involves a relatively small sample from one city in China, so its representativeness is limited. In future research, the sample size will be increased, and the impact of different types of tutoring on primary school students will be explored in depth.

## 6. Conclusion

The purpose of this study was to understand the role of after-school tutoring on primary students with DD. A mixed research methods approach was used to better understand the relationship between the usefulness of tutoring and the factors that influence student participation in tutoring. Ultimately, this study helps primary school students with reading difficulties benefit from after-school tutoring to help them improve their reading comprehension skills.

## Disclosure statement

The author declares no conflict of interest.

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