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18 Test Takers' Strategy Use and Reading Test Performance: A Structural Equation

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Abstract: This study examines the relationships between test takers' strategy use and their reading test performance. Two hundred ninety-six Chinese college test takers responded to a 38-item strategy use questionnaire and a 50-item reading test. Three models of strategy use and test performance were hypothesized and tested. Results showed that college test takers' strategy use affected their lexico-grammatical reading ability (LEX-GR) significantly. Findings are discussed for insights into pedagogical practice.

Key Words: Metacognitive and cognitive strategy use; reading test performance; Chinese test takers; structural equation modeling

Introduction

Language testing researchers have been interested in identifying and characterizing individual characteristics that influence performance on language tests in recent years (Kunnan, 1995). Bachman and Palmer (2010) stated explicitly that test takers' strategy use determines how language ability is actualized in language use.

Similarly, reading researchers have paid increasing attention to the role of strategy use in reading comprehension (Pearson, 2009; Pressley & Afflerbach, 1995; Zhang, 2010). The general consensus is that strategic awareness and monitoring of comprehension, both important aspects of metacognition, distinguishes skilled readers from unskilled ones (Carrell, 1989; Grabe, 2009; Paris & Jacob, 1984; Paris & Winograd, 1990).

Although this line of research has provided useful insights into effects of learners' strategy use on their reading performance, none of the studies have validated the results across samples. Thus, the goal of the current study is to investigate the effects of students' strategy use on reading test performance and validate the results across two samples of similar characteristics.

Strategy Use and Reading Performance

Metacognition is "knowledge and cognition about cognitive phenomena" (Flavell, 1979, p. 906). It is argued that metacognition comprises three components: metacognitive knowledge, metacognitive experience, and strategy use (e.g., Vandergrift & Goh, 2012; Wenden, 1998). This study focuses on test takers' strategy use in a reading comprehension test. Research shows that strategy use plays an important role in many cognitive activities regarding language use (e.g., Goh, 2008; Mokhtari, Sheorey, & Reichard, 2008; Song & Cheng, 2006). For example, Bachman and Palmer (2010) argued that metacognitive strategies determine how language is realized in actual language use. Furthermore, Cohen and Upton (2006) and Cohen (2006) suggested that test takers manage and control their test-taking processes through planning, evaluating, and monitoring.

Similarly, much research has shown that strategy use is closely related to students' reading comprehension performance (e.g., Alderson, 1979; Anderson, 1991; Anderson, Bachman, Perskins, & Cohen, 1991; Brown, 1980; Baker & Brown, 1984; Carrell, 1989; Jacob & Paris, 1987; Paris, Lipson, & Wixson, 1983; Wen & Johnson, 1997; Zhang, 2010). Researchers have employed a variety of methods to examine the relationship between readers' strategy use and their reading comprehension performance. The studies using questionnaires have addressed the correlational or causal relationship between readers' strategy use and reading performance (e.g., Block, 1986, 1992; Carrell, 1989; Mokhtari &

Reichard, 2002; Phakiti, 2003, 2008; Sheoery & Mokhtari, 2001). The general conclusion is that skilled readers are distinguished from the unskilled readers by their conscious awareness of the strategic reading processes and the actual use of reading strategies.

Based on the relevant literature, we hypothesized three models (i.e. unitary model, higher-order model and correlated model) to examine the relationships between test takers' strategy use and their reading test performance. First, it was hypothesized in the unitary model that test takers' metacognitive and cognitive strategies play a unitary role in enhancing their reading test performance. According to the higher-order model, test takers' strategy use was hypothesized to have direct effects on students' test performance. In the correlated model, it was hypothesized that test takers' metacognitive strategy use is correlated with their cognitive strategy use. In addition, metacognitive and cognitive strategy use were hypothesized to have direct effect on students' test performance respectively.

The current study addresses the following two research questions:

1. Which model of strategy use and reading test performance fits the data best, the unitary, higher-order or correlated model?
2. What are the relationships between Chinese college test takers' strategy use and reading test performance?

Method

Participants

296 Chinese college students were invited to participate in the study by filling out the consent form, answering the questionnaire, and sitting for the reading comprehension test. There were 130 (43.9%) male and 162 (54.7 %) female students between the ages of 18 to 24 (M= 19.36; SD=0.92).

Instruments

There are two majors instruments used in the current study: the reading strategy use questionnaire and the CET-4 reading subtest.

The Reading Strategy Questionnaire. This questionnaire has 38 items measuring test takers' metacognitive and cognitive strategy use comprising seven subscales, i.e. planning (PLA), evaluating (EVA), monitoring (MON), initial reading (INI), identifying important information (IDE), integrating (INT), and inference-making (INF) strategies. Metacognitive strategies consist of *planning* (for achieving pre-established goals), *evaluating* (for assessing tasks and personal cognitive abilities), *monitoring* (for checking and regulating performance) strategies, while cognitive strategies are composed of *initial reading* (for engaging in general reading of the text), *identifying important information* (for refining understanding of the text), *inference-making* (for bridging information gaps in the text), and *integrating* (for manipulating the text to fit information across the text) strategies. The reliability estimate for the questionnaire is .89 (Cronbach's alpha).

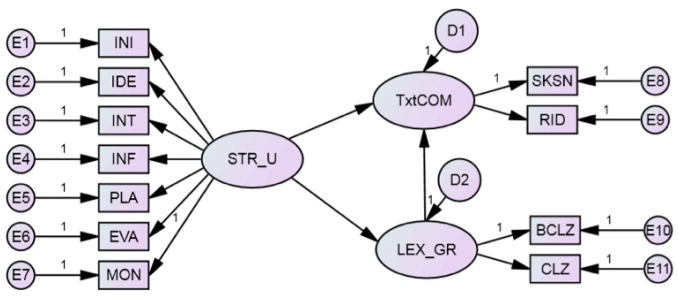
The CET-4 Reading Subtest. A published version of the College English Test Band 4 (CET-4) reading subtest was used to measure test takers' reading test performance. As a nationwide standardized test, the CET is administered by the National College English Testing Committee (NCETC) on behalf of the Chinese Ministry of Education (see Jin, 2008; Yang & Weir, 1998; Zheng & Cheng, 2008). It includes CET-4, CET-6, and CET-Spoken English Test. The CET-4 reading test in this study comprises 50 items and four sections, i.e., 10 skimming and scanning items (SKSN), 10 banked cloze items (BCLZ), 10 items measuring in depth reading (RID), and 20 multiple choice (MCLZ) cloze items.

Data analysis

Preliminary statistical analyses. Descriptive statistics and reliability of the questionnaire and the reading test were calculated. Assumptions regarding univariate normality and multivariate normality were examined. Values of sknewness within ±3 and kurtosis within ±10 indicated univariate normality (Kline, 2011). Multivariate normality was evaluated using Mardia's coefficient. A value of 5.00 or below showed multivariate normality (Byrne, 2006).

Structural equation modelling (SEM). A growing number of studies in language assessment have adopted the approach of structural equation modeling, especially in investigating learners' strategy use and test performance (In'nami and Koizumi, 2011; Kunnan, 1998). Based on the literature, three models of strategy use and reading test performance were hypothesized and tested: (a) a unitary model (see Figure 1); (b) a hierarchical trait model (see Figure 2); and (c) a correlated model (see Figure 3).

Figure 1: The unitary model



Note. INI = initial reading strategies;
IDE = identifying important information strategies;
INTE = integrating strategies;
INF = inference-making strategies;
PLA = planning strategies;
EVA = evaluating strategies;
MON = monitoring strategies;
STR_U = strategy use;
TxtCOM = text comprehension reading ability;
LEX-GR = lexico-grammatical reading ability;
SKSN = Skimming and Scanning;
RID = reading in depth;
BCLZ = banked cloze;
CLZ = multiple-choice cloze

Figure 2: The higher-order mod

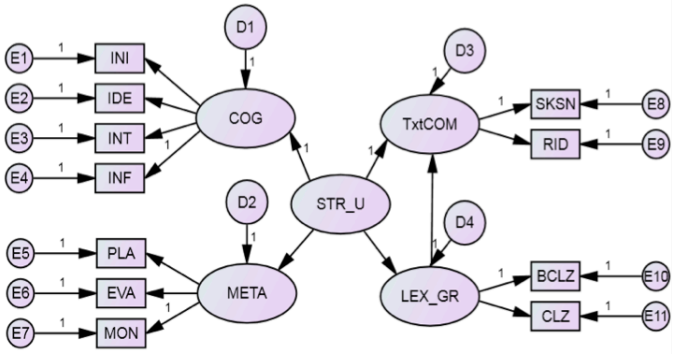
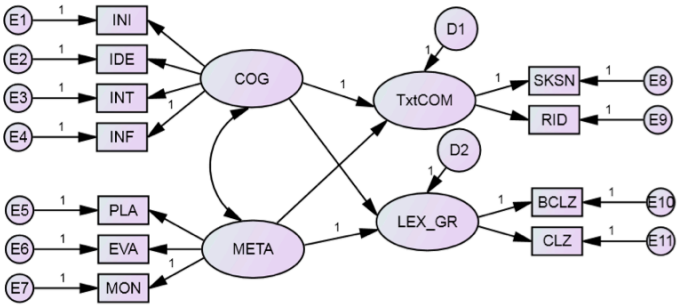


Figure 3: The correlated model



To investigate the model fit, we calculated multiple fit indices. The non-significant chi-square (χ^2) value indicates good model fit. Due to its sensitivity to sample size (Kline, 2011), we calculated the chi-square to degree of freedom ratio (χ^2/df) and an ideal value should be less than three. The comparative fit index (CFI) is required to be equal to or greater than .90 for a reasonably good model fit (Hu & Bentler, 1999; Byrne, 2011). The root mean square error of approximation (RMSEA) should be less than .08 indicating reasonable error of approximation (Browne and Cudeck, 1993). The narrow interval of the RMSEA 90% confidence interval is an indication of better model fit. The standardized root mean square residual (SRMR) below .10 is indicative of good model fit (Kline, 2011). The lower value of the Akaike Information Criteria (AIC) and the Consistent Akaike Information Criteria (CAIC) shows good model fit.

We used IBM SPSS AMOS computer program Version 20.0 (Arbuckle, 2011) to perform the analyses. Maximum Likelihood (ML) was chosen as the method of parameter estimation.

Results

Preliminary statistical analyses

Descriptive statistics of the questionnaire and reading test were calculated. All values of skewness and kurtosis were within the accepted range for the univariate normality. Mardia's coefficient was 3.14 smaller than 5.00, representing multivariate normality. Reliability estimates for the reading strategy use questionnaire and the reading test were .89 and .90 (Cronbach's alpha), showing that the questionnaire and the test are reliable measuring instruments

Structural equation modelling (SEM)

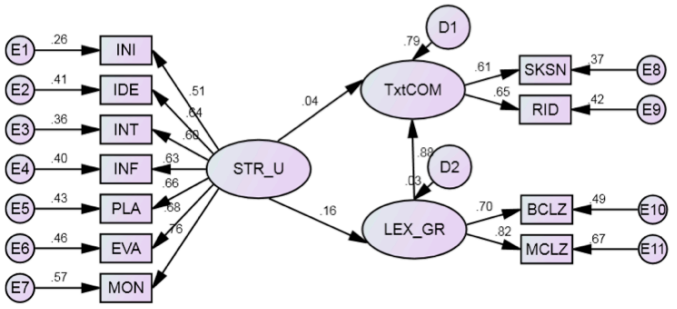
We tested the three hypothesized models. As shown in Table 1, the unitary model fit the data well. Although the chi-square statistic was significant (χ^2 =109.74, df= 43, p < .05), the other fit indices showed a good model fit : CFI=.92, RMSEA=.073[90% confidence interval: .056, .089], and SRMA=.057. In addition, although the higher-order model also seemed to fit the data well, it had a negative error variance for the metacognitive strategy factor. If the problematic variance is fixed to zero to solve the problem, the model becomes meaningless and not interpretable. The correlated model had also the similar problem of a negative error variance associated with RID and MCLZ. Additionally, its model fit is not satisfactory. Based on these, the unitary model appears to fit the data best both statistically and substantively.

Table 1: Fit indice for the three models

	χ^2	df	χ^2/df	CFI	RMSEA	RMSEA 90% CI	AIC	CAIC	SRMR
Unitary model	109.74*	43	2.55	.92	.073	.056 to .089	177.74	278.06	.057
Higher-order model	111.31*	40	2.78	.91	.078	.061 to .095	185.31	300.85	.071
Correlated model	202.58*	41	4.94	.80	.116	.100 to .132	274.58	368.66	NA

Note. df = degree of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; RMSEA 90% CI= RMSEA 90% confidence interval; AIC= Akaike Information Criteria; CAIC= Consistent Akaike Information Criteria; SRMR = Standardized Root Mean Square Residual. NA=not available *p < .05

Figure 4: The final SEM model



Discussion

In this study, the relationships between Chinese college test takers' strategy use and their reading test performance were investigated using structural equation modeling approach. This section discusses the results in relation to the two research questions.

RQ 1: Which model of strategy use and reading test performance fits the data best, the unitary, higher-order or correlated model?

Based on the relevant literature, we hypothesized, tested and compared the unitary, higher-order, and correlated models. Our analyses showed that although the higher-order model yielded good model fit indices, it is impossible to solve the problem of negative error variance, we decided not to select it. Therefore, the unitary model proved to be the best fitting model.

Based on our analysis, the good fit of the unitary model backs up researchers' earlier views (e.g., Baker, 1991; Chapelle et al., 1997; Paris et al., 1991) that metacognitive and cognitive strategies are not distinguishable in that the distinction of the two types of strategies depends on the variation of topic, task, and individuals. In other words, if strategies are set in a complex series of behaviours or decisions, it is difficult to make a distinction between metacognitive and cognitive strategies. A case in point is the strategies used in the test context in which students employ multiple strategies concurrently to deal with the language and test tasks demands to enhance their test performance. Thus, metacognitive and cognitive strategies function collectively, accounting an important portion of variance of test performance.

RQ 2: What are the relationships between Chinese college test takers' strategy use and reading test performance?

As showed in our analyses, STR_U was well measured by the seven measured variables of strategies (i.e., β varied from .51 to .76). In addition, it was found that the CET-4 reading subtest had two underlying factors: lexico-grammatical reading ability (LEX-GR) and text comprehension reading ability (TxtCOM). Furthermore, LEX-GR affected TxtCOM directly and significance with β=.88. This finding is consistent with relevant established theories as well as empirical studies (see Alexander & Jetton, 2000; Anderson & Pearson, 1984; Gough & Tunmer, 1986; Grabe, 2009; LaBerge & Samuels, 1974; Phakiti, 2008b; Purpura, 1997; 1998; 1999; 2004; Zhang & Zhang, 2013).

With regard to the relationship between test takers' strategy use and reading test performance, it was found that test takers' strategy use affected their LEX-GR significantly (β=.16, $p < .05$) while the effect of strategy use on TxtCOM is relatively weak (β=.04). This finding can be interpreted with Rummelhart's (2004) and Stanovich's (1980) information processing model. According to this model, readers use strong skills to compensate for their weak skills in constructing meaning from the context. In other words, as English language learners, the test takers in the current study would make up for their lack of English proficiency by employing strategies. However, strategies appear to play a more important role in responding to the items which tap into learners' lexico-grammatical reading ability. But the compensating role of strategies seemed to be limited in answering the items which tap into learners' text comprehension reading ability which requires higher level skills. This finding is backed up by Bachman's (1990) argument that in contrast to language ability, the dominating contributor to test takers' test performance, strategy use can only account for a small portion of variance of test performance as it is only part of test takers' characteristics that affect language test performance.

Furthermore, the good fit of the unitary model with the data lends support to researchers' earlier views (Baker, 1991; Chapelle et al., 1997; Paris et al., 1991) that the distinction between metacognitive and cognitive strategies hinges on the variation of topic, task, and individuals involved. This appears to show that when language users are faced with a series of complex behaviours or decisions, the strategies they employ to deal with the required tasks are not clearly distinguishable. In the test context, a wide range of sources of information and task demands are presented to test takers under time constraints. Therefore, they tend to use multiple strategies simultaneously to deal with language and test tasks demands in order to maximize their test performance. This is substantiated by the unitary model in which metacognitive and cognitive strategies function in synergy and collectively explain a significant portion of variance in reading test performance in a unitary manner.

Conclusions and Implications

This study investigates the relationships between test takers' strategy use and reading test

performance. Results showed that the unitary model is a better fitting model than high-order model and correlated model. In addition, we found that strategy use affected test takers' lexico-grammatical reading ability significantly but had limited effect on their text comprehension reading ability.

Our findings suggests that instructions on strategy use can influence test takers' reading performance but its function appears to be limited. In other words, to enhance students' test performance, teachers would need to focus more on how to improve students' language proficiency. Additionally, test takers should attach emphasis to improving their comprehensive language ability as well as practicing employing strategies on the test.

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