Aptitude for interpreting: the predictive value of cognitive fluency

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Abstract

Cognitive factors have been recognised as important in the inter- preting process, but whether they could serve as valid components of interpreting aptitude still awaits further investigation. This study explores the predictive value of cognitive fluency in the simulta- neous interpreting (SI) performance of trainee interpreters. Cognitive fluency measures of lexical access, lexical retrieval, lin- guistic attention control and working memory capacity were tested at the beginning of SI training. Simulated SI tasks were conducted at the start and the end of an intensive training period of one academic term. Results of the analyses suggest that (1) cognitive fluency measures could predict a large degree of variance in trainee interpreters' SI performance at the initial stage of SI training, but could only predict the SI performance when the cognitive load was comparatively high after training; and, (2) cognitive fluency con- structs that were significantly related to SI performance differed before and after training. It is concluded that constructs of cognitive fluency might serve as predictors for interpreting performance, but the predictive value of cognitive fluency was influenced by cogni- tive load and interpreter training. Findings of the study provide

Key words

Cognitive fluency; interpreting aptitude; cognitive load; interpreter training

1. Introduction

With the professionalisation of interpreting and an increasing demand for highly qua- lified interpreters, the selection of interpreting candidates has become not only a practical necessity for training institutions, but also an ethical issue (Russo 2011). A wealth of literature on the constituents of interpreting aptitude as well as their testing methods and reliability has been published (e.g., Mayor and Jesus 2015; Russo 2014; Shang and Xie 2020; Zha 2016). Simultaneous interpreting (SI) is a complex and highly cognitively demanding language processing task which involves concurrent source language com- prehension and target language production skills.

Despite the fact that ample evidence has been provided for the predictive power of cognitive abilities for language learning proficiency, research on cognitive components of interpreting aptitude has been scarce. The review conducted by Russo (2011) shows that interpreting-related cognitive skills may be predictive for interpreting performance. Relevant studies have used varied aptitude tests involving different types of cognitive skills (López Gómez et al. 2007; Macnamara et al. 2011; Macnamara, Brooke and Andrew 2016; Shaw 2011; Timarová and Salaets 2011). Some of these studies have taken interpreter training as a mediating factor in their investigation (Macnamara et al. 2011; Macnamara, Brooke and Andrew 2016; Shaw 2011). However, these investigations often fail to include factors of source speeches in their research design, such as how the input rate might influence interpreting performance (Song, Li, and Zha 2021).

Cognitive fluency refers to the efficiency of cognitive processes, including the mobi- lisation, integration, and coordination of mental processes responsible for utterance production (Segalowitz 2010). It involves cognitive processes of 'speed and efficiency of semantic retrieval, the handling of the attention–focusing demands inherent in utterance construction, operations in working memory, among others' (Segalowitz 2016, 82). These processes are generally recognised as important for interpreting. But many of the previous cognitive interpreting studies have paid more attention to domain-general cognitive resources, while constructs of cognitive fluency have included both linguistic knowledge and skills and non-linguistic features (De Jong et al. 2013). Cognitive fluency offers a pertinent combination of potential cognitive factors for designing an interpreting aptitude test.

In this paper, which extends our previous work (Song 2020; Song and Li 2020), we study such indicators as lexical access, lexical retrieval, linguistic attention control and working memory capacity and explore how they predict cognitive fluency for interpret- ing performance. This design is based on previous findings in language learning and interpreting research (Christoffels et al. 2003; De Jong et al. 2013; Segalowitz and Freed 2004; Segalowitz and Frenkiel-Fishman 2005). Lexical access is the availability of lexical entries from a mental lexicon (Field 2004), and is a fundamental skill required for most aspects of language performance. Lexical retrieval involves the selection of lexical con- cepts which are subsequently encoded to be either articulated or written down (Snellings, Amos, and Kees 2002). For linguistic attention control, this is reflected by a person's ability to shift the attention focus from one language-based attention-directing function to another (Segalowitz and Frenkiel-Fishman 2005). Linguistic attention control is language-specific, and differs from the shifting function of domain-general cognitive control. Working memory has been defined as 'a limited capacity system allowing the temporary storage and manipulation of information' necessary for complex tasks such as comprehension, learning and reasoning (Baddeley and Hitch 2000, 48).

Specifically, by exploring the role of different constructs of cognitive fluency in the predictive validity for interpreting performance, the present study hopes to examine how cognitive fluency impacts trainee interpreters' SI performance under two types of con- ditions (namely, low and high input rates) at the start and end of a training session which lasts one academic term. The current study includes both the input rate and the level of interpreter training in the research design, as these may have effects on the predictive value of cognitive fluency.

2. Literature review

2.1 Interpreting aptitude research

Aptitude is a multifaceted concept. As an overall term encompassing abilities, skills and personal traits, it also refers to reliable predictors of successful interpreter training (Russo 2011). Different components of interpreting aptitude have been proposed by a number of scholars (Gerver et al. 1984; Lambert 1991; Moser-Mercer 1994). Some common qualities and abilities desired in prospective interpreters include proficient command of lan- guages, bilingual conversion abilities, general knowledge, good memory, and stress resilience.

Validated and reliable aptitude tests have been used in the past to single out skills relevant to interpreting (Russo 2011). Language ability, cognitive skills, and soft skills such as motivation are important aspects in the consideration of interpreting aptitude. Forms of tests include psychometric tests (Gerver et al. 1989), oral paraphrasing (Russo and Pippa 2004; Russo 2014), the SynCloze test (Pöchhacker 2011), neuropsychological tests (Shaw 2011; Timarová and Salaets 2011), the cognitive shadowing test (Chabasse and Kader 2014), and recall across languages (Shang and Xie 2020), among others. The metrics of such tests have targeted individual skills or multiple skills, for instance, interlinguistic recall, which implies both foreign language control and memory (Russo 2011).

To verify the validity of interpreting aptitude tests, more recent studies have correlated aptitude test results and scorings of subsequent interpreting performance or established statistical models. Russo and Pippa (2004) and Russo (2014) found that loss of coherence and synonym substitution, which involve semantic processing and memory capacity, were two of the most powerful predictors for interpreting performance. Similarly, second language (L2) listening proficiency was found to have a significant effect on students' interpreting ability in the investigation by Mayor and Jesus (2015). Most recently, the predictive validity of recall across languages was confirmed in the study of Shang and Xie (2020), who found that candidates' performance in the recall task could predict their end- of-year interpreting performance.

2.2 Cognitive fluency and interpreting

Cognitive fluency indicates the capacity to process mentally challenging tasks efficiently with relative ease and fluidity (see Introduction). It has been found to be important for oral production in second language learning, where it is understood as the ability to produce L2 utterances efficiently. In the context of interpreting, cognitive fluency is used to describe the ability to access, comprehend, retain or reproduce meanings efficiently in source and target languages. A study by Segalowitz and Freed (2004) indicated that L2-specific cognitive processing was implied in oral performance. They found that, whereas lexical access played a positive role in oral fluency in the pre-tests, linguistic attention control exerted a negative influence on speech rate in the post-tests. Another study in the same line by De Jong et al. (2013) explored to what extent the fluidity of oral performance could be explained by measures of L2 linguistic knowledge and processing skills under- lying L2 cognitive fluency. Their study revealed that the constructs of utterance fluency were associated with different measures of cognitive fluency. A more recent study by Hu and Wang (2017) found that, compared with utterance fluency predictors, the inclusion of cognitive fluency measures in the regression model significantly improved its pre- dictive power for L2 oral competence, which sheds light on the relationship between cognitive fluency and overall oral proficiency. These findings provide some basis for the assumption that cognitive fluency could be predictive of interpreting performance. In previous studies of Song (2020) and Song and Li (2020), we focused on the dimension of fluency in interpreting and reported findings on the role of cognitive fluency in the development of utterance fluency in trainee interpreters' SI output. In this study, we pay attention to the overall interpreting performance and explore to what extent constructs of cognitive fluency could predict trainee interpreters' SI performance.

Interpreting scholars have been working towards understanding the relationship between cognitive resources and interpreting performance, though many of their find- ings remain inconclusive. Interpreting performance was found to be correlated to the latency of lexical retrieval and associated with memory ability (Christoffels et al. 2003). However, Cai et al. (2015) failed to find a significant impact of lexical retrieval on the consecutive interpreting (CI) performance of beginner trainee interpreters. The predic- tive power of cognitive abilities for interpreting performance has been explored in a number of studies. The study of Macnamara et al. (2011) suggests that a combination of domain-general cognitive abilities and personality traits might be predictive of future interpreting effectiveness. In terms of working memory, different functions of working memory were found to predict different sub-processes in SI, but in complex patterns (Timarová et al. 2014). The working memory capacity of trainee interpreters was found to be able to predict both the overall interpreting performance (Chmiel 2016; Macnamara, Brooke and Andrew 2016) and the occurrence of disfluencies in trainee interpreters' SI output (Lin, Lv, and Liang 2018). Specifically, the unique contribution of working memory capacity was confirmed in the study of Song and Li (2020), which found that the inclusion of working memory capacity significantly increased the pre- dictive power of cognitive fluency for trainee interpreters' SI utterance fluency development.

Overall, a positive correlation has been observed between working memory and the quality of simultaneous interpreting. However, these research findings have not been able to determine conclusively 'whether individuals with stronger working memories are those who are likely to find success in the field' (Mellinger and Hanson 2019, 184). The effects of cognitive control on interpreting output still requires systematic research (Dong and Li 2019). Moreover, studies on cognitive control of interpreters mostly focus on domain-general cognitive functions instead of language-specific ones, which is a vital aspect of simultaneous interpreting proficiency.

2.3 Interpreter training effects

Formal training aims to help trainees to 'enhance their performance to the full realization of their potential' (Gile 2009, 7). Some scholars have investigated whether interpreter training brings significant cognitive differences in interpreters (Dong, Liu, and Cai 2018; Dong and Liu 2016; Babcock and Vallesi 2017), although no consensus has been reached. Interpreter training has been found to bring significant neurocognitive improvements in subjects with sustained interpreting experience, but it seems that cognitive effects of interpreter training are non-generalisable beyond directly taxed functions (García, Muñoz, and Kogan 2019). Longitudinal studies on the effects of interpreter training on trainees' outcome performance are few in number, but most studies have confirmed a number of effects. Hervais-Adelman, Moser-Mercer, and Golestani (2015) for example, found that the performance of trainee interpreters improved, and the response latencies were shorter after training, which implied the impact of SI training on the brain functional response. The amount of training was identified as one of the positive predictors for final SI performance in the research of Macnamara, Brooke and Andrew (2016). Furthermore, the findings presented by Chmiel (2021) have suggested that word- translation accuracy and latency improved as a result of interpreter training, although they were no longer enhanced in the process of professional interpreting practice. Based on these findings, the role of cognitive fluency constructs might vary with the develop- ment of interpreting expertise. Thus, interpreter training is included as a mediating factor in the research design of the present study.

As reviewed above, the question of whether cognitive fluency constructs could serve as valid components of interpreting aptitude still awaits further investigation. To this purpose, the current study proposes the following research questions (RQ):

> RQ 1: To what extent can constructs of cognitive fluency predict trainee interpreters' SI performance under conditions of low and high input rates at different stages of interpreter training?

> RQ 2: What role do cognitive fluency predictors play in trainee interpreters' SI performance under conditions of low and high input rates at different stages of interpreter training?

3. Research methods

3.1 Participants

Participants were recruited using a convenience sampling method. Twenty-eight trainee interpreters, 26 female and 2 male, were recruited from the Masters of Interpreting programmes at three universities based in Hong Kong. All of them, except one female participant, were native Chinese speakers with English as their second language. To maintain the homogeneity of the participants, this female participant was excluded from the study, leaving 27 participants in total. The participants had on average received three academic terms of consecutive interpreter training, with a mean age of 23.7 years (SD = 1.27) and a mean IELTS (International English Language Testing System) score of 7.41 (SD = 0.36). All these participants had just started their SI training when the experiment was conducted.

In the period under investigation, the participants received three-hours of intensive SI training each week for one academic term. The teachers commented on their on-site interpreting performance and gave instructions on SI strategies and solutions for diffi- culties they encountered. Participants were assigned authentic conference speeches of varying topics for after-class interpreting practice. Each participant spent around 15– 20 hours each week on SI practice. Participants signed consent forms to participate in the experiment voluntarily. Cash reward was offered for the completion of all experimental sessions.

3.2 Instruments

3.2.1 Cognitive instruments

3.2.1.1 Semantic classification task. The semantic classification task for the test of lexical access (LA) was adapted from designs by Segalowitz and Freed (2004) and Snellings, Amos, and Kees (2002). Participants were required to make two-alternative animacy judgements on whether a single noun word on the screen referred to an animate object or not. The English words used for stimulus were largely the direct translations of the corresponding Chinese stimuli. The frequency of stimuli was controlled with refer- ence to the frequency lists of Davies and Gardner (2004) and Xiao, Rayson, and McEnery (2009). For the experimental procedure, fifty animate and fifty inanimate words were presented on the screen and recycled twice, leading to a total number of 200 trials. The experiment began with a fixation cross on the screen for 150 ms, followed by a stimulus shown on screen for 3000 ms. When a key response was detected by Chronos, a highly accurate external device which records key or sound responses, a blank screen appeared for 500 ms. All the stimuli were randomised and the sequence of L1 and L2 versions were counterbalanced across participants. Reaction time and accuracy were recorded.

3.2.1.2 Word translation task. The word translation task for the test of lexical retrieval (LR) was adapted from tasks of Christoffels et al. (2003) and De Groot and Poot (1997). Participants were required to say aloud the target translation equivalent of the presented word as soon as it appeared on the screen. The translation direction tested was L2-L1 (English to Chinese). The stimulus words were manipulated in terms of frequency, concreteness, imaginability and word length. In the experimental block, 100 English stimulus words were presented on the screen randomly. In each trial, a fixation cross was presented for 500 ms, followed by a 100 ms interval of blank screen before the stimulus word appeared. The stimulus word stayed on screen for 5000 ms until a voice response was detected through a microphone and Chronos. The reaction time was registered. Participants were instructed to remain silent if they did not know the target translation equivalent. Response accuracy was checked based on the recordings.

3.2.1.3 Category judgment task. The category judgement task for the test of linguistic attention control (AC) was adapted based on previous research (Hu and Wang 2017; Segalowitz and Frenkiel-Fishman 2005) and adopted the alternating runs paradigm (Rogers and Monsell 1995). Two sets of stimulus words were used. One set indicated ‘the past’ and ‘the future’ and the other set indicated low and high frequency. Participants judged which time or frequency category the stimulus words belonged to and made key responses through Chronos. The tasks were administered in both L1 and L2.

Altogether, there were 16 blocks, including eight L1 and eight L2 blocks that were presented in an alternative manner. Within each block, the two judgement tasks (Time and Frequency) alternated in the sequence ‘ . . . TTFFTTFFTTFF . . . ’, which represents an alternation pattern between repeating and shifting conditions in a predictable way. The difference between shifting and repeating conditions is referred to as shift cost (Segalowitz and Frenkiel-Fishman 2005). A list of 48 stimulus words was compiled by repeating the eight 'time' words and eight 'frequency' words in each block three times. Displayed in a clockwise manner, these stimuli were further placed in the four quadrants of a square of the computer screen. These stimulus words stayed on the screen until a response was made, or for 5000 ms with no response. The reaction time was registered, and the shift costs were calculated.

3.2.1.4 Speaking span task. The speaking span task for the test of working memory capacity taxes the processing and storage of memory simultaneously during the produc- tion process (Daneman and Green 1986). The task follows previous research in design (Christoffels et al. 2003; Daneman and Green 1986; Maria da Glória 2013) and was tested in both L1 and L2 versions. Sixty unrelated English words were presented on screen for 1000 ms, followed by a 500 ms blank. All these words were grouped in three sets, within which no words were similar to each other either in meaning or in sound. Among the 20 words in each set, the two, three, four, five and six-word sets were shown successively. Participants were required to verbally generate a set of grammatically and semantically acceptable sentences for the words that were shown to them in exactly the same order and form one by one. The indicator of strict speaking span (SSS) was used in the study for speaking span. This refers to the total number of words for which grammatically and semantically acceptable sentences are produced with the exact form of presented words, and it does not require the order to be the same as the presented order (Daneman and Green 1986; Daneman 1991). The maximum SSS score is 60.

3.2.2 Interpreting materials

In interpreting tasks, four source speeches which were modified from authentic speeches were used. Two of them were used for the pre-training tasks, and the rest for the post- training tasks. The speeches were about 1,500 words in length and were on general topics and delivered by the same speaker on the same occasion. Key linguistic features of the four speeches were comparable according to the lexical, syntactic and LSA (latent semantic analysis) parameters derived using the analytic tool Coh-Metrix (Graesser et al. 2004). Several representative indexes were reported in the following. The mean type- token ratio of the four speeches was 0.58 (SD = 0.02); the mean number of modifiers per noun phrase was 0.71 (SD = 0.03); and the LSA give/new (the average givenness of each sentence) was 0.29 (SD = 0.01). Both a slower version with 120 words per minute and a faster version with 140 words per minute were prepared for each speech through manipulation. The adapted versions of the speeches were all confirmed by two profes- sional interpreters for their suitability (including speed and level of difficulty) for interpreting.

3.3 Procedures

3.3.1 Cognitive fluency tasks

Four cognitive tasks, as described in section 3.2.1, were administered at the beginning of SI training. These tasks consist of a semantic classification task for testing lexical access (LA), a category judgement task for assessing linguistic attention control (AC), a word translation task for evaluating lexical retrieval (LR) and a speaking span task (SS) for examining working memory capacity. The procedures of cognitive tasks were the same as that in Song (2020) and Song and Li (2020). The tasks were presented on a 14-inch ThinkPad laptop screen using E-prime 2.0 (Schneider and Zuccoloto 2007). Participants responded through Chronos and a microphone. The administration of the four cognitive fluency tasks took about two hours.

3.3.2 Interpreting tasks

We administered the simulated SI tasks at the beginning and the end of an SI training session which lasted 13 weeks. Participants interpreted two speeches simultaneously in sound-proof SI booths. A double-track recording system was used to digitally record their interpreting performance.

In the experiment, the participants interpreted two different versions of the speeches, namely, a slower version of one and a faster version of the other (see 3.2.2). The orders of speeches were counter-balanced using Latin-square design. A briefing note of the topics, background information, together with a list of the key reference terms were given out to participants ten minutes before the experiment commenced. The participants also got a chance to familiarise themselves with the speaker's oratory style by listening to a warm- up speech which was made by the speaker on the same occasion. Participants started interpreting only when they felt ready for the task. When participants finished interpret- ing the first speech, they were required to rate the difficulty level of the source speech and their SI performance by completing a questionnaire. To reduce fatigue, participants were asked to take a rest for a minimum of ten minutes when they finished the questionnaire.

3.4 Rating

Assessment of the trainee interpreters' SI performance was operationalised as ratings by a homogenous group of three human raters (Hamidi and Pöchhacker 2007; Lee 2008). The use of multiple raters is believed to reduce uncertainties of measurement and incon- sistencies across raters, thus contributing to rating reliability (Han 2018) All three raters in this group were native Chinese speakers with a proficient command of English and had professional interpreting experience. Two raters were full-time interpreting teachers with five and seven years of professional interpreting experience respectively and had been teaching interpreting in universities for about five years. The third rater was an interpreting practitioner with two years of SI experience as well as a part-time interpret- ing teacher for local tertiary institutions.

Raters had undergone the same training process before they began the rating. During the training, they were informed about the context of rating, the construct and content of the interpreting tasks, and the rating criteria. A trial run for rating was conducted by the raters and explained by the researchers. The interpreting files, four for each participant, were then distributed to each rater in a random order.

Raters completed their post-hoc rating individually at their convenience. Post-hoc rating (Han 2015; Wang and Napier 2015) was adopted due to geographical and work- load constraints, both of which made group rating on-the-spot impossible. Raters were also given source texts and suggested translations for their reference. Three main criteria of SI performance, i.e., content, delivery and language quality, were included in the assessment (Han and Slatyer 2016; Lee 2008). Descriptor-based rating scales that were composed of five bands, namely, 90–100, 80–89, 70–79, 60–69 and 0–59 were developed for the rating process. When ratings were completed by all the raters, a weighted average for each recording was calculated.

4. Data analysis and results

We performed multiple linear regression analyses to examine the predictive value of cognitive fluency for trainee interpreters' overall SI performance by using SPSS 26.0. The independent variables are constructs of cognitive fluency, and SI performance ratings are dependent variables. Before regression analyses, correlation analyses between measures of cognitive fluency were conducted to avoid the problem of multicollinearity. Inter-rater reliability was measured to ensure the agreement between ratings of SI performance. ANOVA analyses were conducted to further investigate the specific role of some of the cognitive fluency constructs in interpreting performance.

4.1 Rating reliability

Inter-rater reliability is the agreement between raters on the same assessment, i.e., raters giving the same or similar scores to the same performance (Sawyer 2004). In the present study, inter-rater reliability was measured using Kendall's coefficient of concordance (W). This measure, which ranges from 0 (complete disagreement) to 1 (perfect agreement), is an efficient way to assess agreement between observers (Gearhart et al. 2013; Kendall and Babington Smith 1939). The agreement is regarded as strong when Kendall's W is within the 0.71–0.90 range and very strong when it is above 0.9 (LeBreton and Senter 2008).

Inter-rater reliability was conducted for the following four conditions respectively: pre-training low input rate (Pre_S), pre-training high input rate (Pre_F), post-training low input rate (Post_S) and post-training hight input rate (Post_F). It was found that three raters gave consistent ratings for the overall SI performance with strong agreement. As shown below, the global concordance (W) values ranged from 0.728 to 0.787.

- Pre_S retrieved a value of *Kendall W* = 0.728, $p < 0.001$,
- Pre_F *retrieved a value of Kendall W* = 0.731, $p < 0.001$,
- Post_S retrieved a value of *Kendall W* = 0.756, $p < 0.001$, and,
- Post_F retrieved a value of *Kendall W* = 0.787, $p < 0.001$.

All *p* values were significant at the < 0.05 level.

4.2 Correlation analysis

Descriptive statistics for measures of cognitive fluency are presented in Table 1. To avoid the problem of multicollinearity, we also conducted correlation analyses between all cognitive fluency measures so as to select independent variables for regression analyses. As shown in Table 2, the results reveal that significant correlations were observed between LA EN and LA CH ($r = 0.811$, $p < 0.001$), and between SS EN and SS CH ($r = 0.702$, $p < 0.001$). So, only one measure for the lexical access and one for speaking span tasks were retained, since the English and Chinese measures of these two tasks were highly correlated. In the end, five parameters, including English lexical access (LA EN), lexical retrieval (LR), English linguistic attention control (AC EN), Chinese linguistic attention control (AC CH), and English speaking span (SS EN), were retained as the independent variables for regression analyses.

Table 1. Descriptive statistics of cognitive fluency parameters.

Cognitive fluency		Index	Mean	SD	Range
Lexical Access (LA)	RT	LA EN	695.750	95.157	352.000
		LA CH	596.180	89.266	346.000
Lexical Retrieval (LR)	RT	LR	1084.070	122.439	427.000
Linguistic Attention Control (AC)	RT	AC EN	88.050	73.894	284.000
		AC CH	72.710	106.003	564.000
Working Memory Capacity (SS)	SSS	SS EN	32.040	8.405	30.000
		SS CH	41.440	6.185	23.000
SI Performance	ratings	Pre_S	80.790	4.131	13.000
		Pre_F	80.136	4.312	14.000
		Post_S	82.555	3.461	14.000
		Post_F	82.877	3.086	13.000

Notes: RT for reaction time; SSS for strict speaking span; Pre for the pre-training tasks; Post for the post-training tasks; S for low input rate condition; F for high input rate condition.

Table 2. Correlations of cognitive fluency parameters.

	LA EN	LA CH	LR	AC EN	AC CH	SS EN	SS CH
LA EN	–						
LA CH	.811**						
LR	−0.02	−0.213					
AC EN	0.322	0.371	−0.039				
AC CH	0.137	0.262	−0.294	0.228			
SS EN	0.02	0.236	−0.37	0.105	0.102		
SS CH	0.114	0.098	−0.298	−0.034	0.028	.702**	–

Notes: ** significant at the 0.01 level (2-tailed).

4.3 Regression analysis

Multiple linear regression analyses were conducted by using such cognitive fluency measures as LA EN, LR, AC EN, AC CH, and SS EN as predictors and SI performance ratings as dependent variables. The analyses were conducted separately under conditions of low and high input rates in pre-training (Pre_S, Pre_F) and post-training tasks (Post_S, and Post_F). Five predictors were applied in the regression model by means of the backward method. Heteroscedasticity, linearity, and normality of the regression models were used for validating whether the linear regression models were reliable or not. No multicollinearity was observed ($VIF < 2.00$, $tolerance > 0.5$). Results of regression analyses are summarised in Table 3.

In the pre-training tasks, the models reached statistical significance both under low input rate conditions [F (2, 26) = 6.995, $p = 0.004$, adjusted $R^2 = 0.316$] and under high input rate conditions [F (2, 26) = 7.844, $p = 0.002$, adjusted $R^2 = 0.345$]. The selected predictors were LA EN and AC EN in these two models. The predictors of LR, AC CH and SS EN were taken out of the models. Results of *t-tests* for regression coefficients showed that LA EN (β = −0.557, t = −3.248, p = 0.003) and AC EN (β = 0.48, t = 2.802, p = 0.01) were significantly related to pre-training SI ratings under low input rate conditions (Pre_S). LA EN (β = −0.609, t = −3.634, p = 0.001) and AC EN (β = 0.446, t = 2.662, p = 0.014) were significantly related to pre-training SI ratings under high input rate conditions (Pre_F). Lexical access was a more powerful predictor than linguistic attention control in the pre-training tasks (β_1 = −0.557, β_2 = 0.48 for the low input rate condition; and β_1 = −0.609, β_2 = 0.446 for the high input rate condition).

Table 3. Results of backward regression analyses.

Dependent variables	R^2	Adjusted R^2	F	Sig.	Predictors	B	Beta	t	Sig.
					(Constant)	95.24		18.999	0.000
Pre_S SI ratings	0.368	0.316	6.995	0.004	LA EN	−0.024	−0.557	−3.248	0.003
					AC EN	0.027	0.48	2.802	0.01
					(Constant)	97.05		18.961	0.000
Pre_F SI ratings	0.395	0.345	7.844	0.002	LA EN	−0.028	−0.609	−3.634	0.001
					AC EN	0.026	0.446	2.662	0.014
Post_S SI ratings					(Constant)	81.009		81.769	0.000
	0.141	0.106	4.087	0.054	AC EN	0.018	0.375	2.022	0.054
Post_F SI ratings					(Constant)	91.121		20.203	0.000
	0.373	0.320	7.129	0.004	LR	−0.009	−0.366	−2.260	0.033
					AC EN	0.020	0.475	2.934	0.007

English attention control was retained in the model for the post-training tasks. All the other four predictors were removed with the dependent variable of SI ratings under low input rate conditions (Post_S). However, the model did not reach significance [F (2, 26) = 4.087, p = 0.054, adjusted R^2 = 0.106], suggesting that the cognitive fluency construct under discussion did not have a significant predictive value for SI performance. The regression model with SI performance under high input rate conditions in the post-training tasks (Post_F) was statistically significant [F (2, 26) = 7.129, p = 0.004, adjusted R^2 = 0.320]. The predictors LR and AC EN were retained in the model and other variables LA EN, AC CH and SS EN were removed. *T-test* results of regression coefficients revealed that the correlation between LR and Post_F ratings reached significance (β = −0.366, t = −2.260, p = 0.033), and AC EN was also significantly related to Post_F ratings (β = 0.475, t = 2.934, p = 0.007).

4.4 ANOVA analysis

To further explore the role of cognitive fluency measures in trainee interpreters' overall SI performance, we conducted repeated measures ANOVA analyses, using the input rate and training as within-subject variables and cognitive fluency measures as between- subject variables. Cognitive fluency predictors which were significant in the regression models were selected for the ANOVA analyses, i.e., LA EN, LR and AC EN. Based on the mean value, they were recoded into a dichotomous variable. The *Bonferroni* method was used for confidence interval adjustment for multiple comparisons, yielding a significant mean difference at the 0.05 level.

Results of the analyses showed that the main effect of LR on SI performance reached significance [F (1, 25) = 5.381, p = 0.029] and there was no significant difference among other comparisons of the cognitive fluency groups. It was shown in the pairwise compar- ison that the rating of the faster LR group was higher than that of the slower LR one by 2.852. It was found that the training has significant effect on the overall SI performance of the trainees with $p < 0.001$, suggesting substantial differences between pre-training and post-training SI performance.

Table 4. Results of simple effects of interaction effects between LA EN and Training.

Training	(I) LA EN	(J) LA EN	Mean Difference (I-J)	Std. Error	Sig.
pre	faster	slower	3.261*	1.472	0.036
post	faster	slower	0.518	1.253	0.683
LA EN	(I) Training	(J) Training	Mean Difference (I-J)	Std. Error	Sig.
faster	pre	post	−1.136*	0.466	0.022
slower	pre	post	−3.879*	0.562	0.000

Notes: The mean difference is significant at the .05 level.

Significant interaction effects between LA EN and training were found [F (1, 25) = 14.132,p = 0.001]. However, there were no significant differences for other inter- action effects among cognitive fluency measures, training and input rate. As revealed in Table 4, analyses of simple effects showed that the effect of LA EN was significant in pre- training SI tasks [F (1, 25) = 4.905, p = 0.036], with the SI ratings for the faster LA EN group higher than that for the slower LA EN group by 3.261. The effect of LA EN was not significant in the post-training tasks [F (1, 25) = 0.171, p = 0.683], indicating no significant differences between the faster and slower lexical access groups in the post- training tasks. The effect of training was significant for both the faster LA CH group [F (1, 25) = 5.945, p = 0.022] and the slower LA EN group [F (1, 25) = 47.680, p < 0.001], with SI ratings in post-training tasks higher than in pre-training tasks by 1.136 and 3.879 respectively.

5. Discussion

Results of the analyses suggest that cognitive fluency measures could predict a large degree of variance in the SI performance of trainee interpreters under conditions of both low and high input rates in the pre-training SI tasks. Lexical access (LA EN) and linguistic attention control (AC EN) measures could explain 31.6% and 34.5% (adjusted R^2) of the variance in trainee interpreters' SI performance under the low and high input rate conditions, respectively. In post-training SI tasks, cognitive fluency measures could only predict trainee interpreters' SI performance under the condition of high input rate. Lexical retrieval and linguistic attention control measures could explain 32.0% (adjusted R^2) of the variance in trainee interpreters' SI performance. Cognitive fluency measures did not have significant predictive value for SI performance when the input rate was comparatively low in the post-training tasks. Overall, the findings suggest that cognitive fluency constructs were significant predictors for trainee interpreters' pre- training SI performance, but measures of cognitive fluency could predict trainee inter- preters' future SI performance only when the input rate was comparatively high in the post-training SI tasks.

Lexical access was a more powerful predictor than linguistic attention control in the pre-training SI tasks, though not a significant predictor for interpreting performance after training. The role of lexical access was a complex one and might be partly illustrated by the interaction effects between LA EN and training. As the results of simple effects showed, differences across the LA EN groups were only significant in the pre-training SI tasks, with the faster LA EN group outperforming the slower LA EN group. The effect of training was significant for both the faster and slower LA EN groups, with SI ratings higher after training. It seemed that the group with slower lexical access at the beginning made greater gains in this criterion after a period of intensive SI training compared to the group with faster lexical access at the start of training. No significant differences between the two LA EN groups in their post-training interpreting performance were found. This might partly explain why lexical access was not a significant predictor for trainee interpreters' performance in the post-training tasks. This finding corroborates previous research on the relationship between lexical access and L2 oral performance (Segalowitz and Freed 2004) and SI fluency (Song and Li 2020). While lexical access efficiency was found significantly related to the development of trainee interpreters' utterance fluency performance in the investigation of Song and Li (2020), the present study confirms the correlation between lexical access and trainee interpreters' overall SI performance, but with a complex pattern as discussed above.

The speed of lexical retrieval (LR), elicited from an oral word translation task, was a predictor only in the post-training SI tasks when the input rate was comparatively high. Pairwise comparison showed that there were significant differences across the LR groups, with the faster LR group outperforming the slower LR group. This finding indicates that the role of lexical retrieval may be related to participants' interpreting experience and be influenced by cognitive load, which could partly explain the discrepancies in previous findings. Christoffels et al. (2003) found that word translation latencies correlated with SI performance, with untrained bilinguals as participants. However, Cai et al. (2015) failed to find a meaningful contribution of lexical retrieval efficiency to CI performance, and their participants were trainee interpreters at the initial stage of interpreter training. Differences in the types of tasks, modes of interpreting and participants' interpreting experience might have contributed to the divergence of findings. A translation recogni- tion task was used by Cai et al. (2015), whereas Christoffels et al. (2003) and the present study chose the translation production task, which tapped into both the retrieval of translation equivalents and their verbal production. SI requires concurrent listening and speaking and poses higher cognitive load on interpreters than CI for which the partici- pants had more time for lexical retrieval. The finding in the present study provides further evidence for the inference that lexical retrieval might play a more significant role in cognitively more demanding task. Moreover, the present study is exploratory in including both lexical access and lexical retrieval tasks in its research design. Findings of the present study indicate that the roles of lexical access and lexical retrieval are different at different interpreter training stages. The development of participants' inter- preting expertise after training, for instance, better coordination of multiple tasks and the use of interpreting strategies, might be part of the reasons for the difference. This suggests the necessity of distinguishing the role of lexical access and lexical retrieval in SI performance. Future studies may explore whether the effect of lexical access and retrieval would exhibit different patterns at different stages of interpreter training.

The present study did not find that working memory capacity (elicited from a speaking span task) was a significant predictor for trainee interpreters' SI performance, whether the task was conducted before or after training. Possible reasons for this discrepancy include an array of factors, such as the variety of memory tasks, interpreting modes, participants profiles, and interpreting experience. Working memory span mea- sures in the study by Cai et al. (2015) were elicited through the digit span, listening span, and speaking span tasks and the mode of task was consecutive interpreting. However, memory capacity tasks in the study by Macnamara, Brooke and Andrew (2016) were the reading span task, operation span task, and digit span tasks, and their participants were sign language interpreters. Consecutive interpreting has a higher requirement for mem- ory storage and sign language interpreting involves the storage of visual information, which are different from simultaneous interpreting. Trainee interpreters' improved working memory capacity scores, tested through the reading span and listening span tasks, predicted better simultaneous interpreting performance after two-year training in the study by Chmiel (2018), but no difference was found when comparing the initial memory scores of successful trainees with those who discontinued their training. The selection of memory tasks may be important when exploring valid predictors for inter- preting performance. Moreover, a relation between working memory capacity and interpreting performance still cannot resolve the issue of causality (Mellinger and Hanson 2019). Further investigation into working memory as a predictor for better interpreting performance is needed to corroborate current findings.

Control of attention has been proposed as a crucial component of interpreting (Cowan 2000). Linguistic attention control was a more powerful predictor for trainee interpreters' SI performance than lexical retrieval in the post-training tasks, though only under the condition of high input rate. The finding is consistent with the previous findings of Song and Li (2020) on the efficiency of linguistic attention control as a significant predictor for trainee interpreters' SI utterance fluency development when the cognitive load was comparatively high, but not under the condition of low cognitive load. However, the predictor for SI utterance fluency development was the linguistic attention control measure in the target language. Though similar patterns were found, fluency and the overall interpreting performance should be investigated as different constructs. Besides, the finding corroborates those of previous studies in that shifting, as a function of cognitive control, is important in interpreting performance (Babcock and Vallesi 2017; Timarová et al. 2014;), though only under conditions of high input rate in the present investigation. It should be noted that linguistic attention control in the present research is language-directed attention, which differs from domain-general cognitive-control abil- ities in most previous studies. Besides, this study only focused on the shifting function of attention control. Future related work could more systematically explore different cog- nitive control functions as potential components of interpreting aptitude and investigate the predictive validity for domain-general and domain-specific cognitive abilities in interpreting.

6. Conclusion

The current study concludes that lexical access and linguistic attention control, being two of the explored cognitive fluency constructs, could serve as important predictors for trainee interpreters' SI performance at the initial stage of interpreter training. After a period of interpreter training for one academic term, measures of lexical retrieval and linguistic attention control could predict SI performance when the input rate was comparatively high. However, working memory capacity was not found to be a signifi- cant predictor for trainee interpreters' SI performance. The study generally suggests that constructs of cognitive fluency might serve as potential interpreting aptitude compo- nents, but the predictive value of cognitive fluency was influenced by factors of cognitive load and training experience. Moreover, cognitive predictors for trainee interpreters' SI performance varied at different stages of interpreter training.

The study offers an inter-disciplinary investigation into the predictive value of cogni- tive fluency in SI performance, providing another perspective for interpreting aptitude research. Methodologically, it seeks ways to enhance the validity of statistical analyses and pays attention to the influencing factors of cognitive load and interpreter training. Findings of the study have important implications for interpreter aptitude testing. It provides empirical evidence for potential inclusion of cognitive fluency measures in the interpreter aptitude tests. Future exploration with a larger participant sample size, long- itudinal study with a longer training period, and the inclusion of bidirectional interpret- ing tasks may be necessary to gain the whole picture of cognitive fluency measure potential.

Funding

The research is funded by The Fundamental Research Funds for the Central Universities "Constructs and Validity of Interpreting Aptitude Test" (22CX04015B).

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